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Government of Madras

Public Works DEPARTMENT

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No. 590. Read the following :—

No. 1,086-A.

MEMORANDUM.

Floods of 1874.

Nature and object of narrative required.

THE Order of Government of the 4th December last, No. 3,411-A., directed the Chief Engineer for Irrigation to draw up a narrative of the disasters caused by the floods of September and October 1874, showing the nature and extent of the damage done to each work and the conjectured cost of emergent repair as well as of thorough renovation, or the provision of such works as would guard against similar disasters in future. Accordingly the District Engineers were called upon to supply the necessary information; and reports, more or less in detail, having now been received, they are reviewed below. It is to be observed that the estimates of the cost of renovation and improvement of existing works, as well as that of providing new ones to prevent future disasters, depends on the information gained by surveys, more or less extensive, which take time and which are not yet completed.

Ganjam detailed list of works damaged.

* Appendix A.

† In October and November 1874.

2. GANJAM.—The District Engineer, Ganjam, has supplied a detailed list* of the irrigation works which were damaged by flood.† It shows that the embankments of one river, four channels, and thirty-eight tanks were breached. Seven masonry works on channels or tanks were destroyed or damaged as well as three bridges. The cost of the emergent repairs will probably not exceed Rupees 10,000, and that of renewing the works, or providing new ones where necessary, is estimated at Rs. 60,650.

Cost of repairs, Rupees 10,000.

Cost of improvements, Rupees 60,650.

It is certain that the latter is merely a rough approximation, for there has been no time to consider carefully and one by one the circumstances of each work and to make the necessary calculations on which alone a reliable estimate could be framed.

It is stated that the damage by flood was greater during the year 1873 than in 1874, as the rainfall in the latter extended over a longer period than during the former year, and that the damage now brought to notice was chiefly in the southern portion of the district, where the freshes were higher than any within recollection.

General condition of Irrigation Works in the Ganjam District.

3. In reference to the general condition of the irrigation work, the District Engineer explains that few of the tanks are provided with masonry works of any kind, that river embankments have been much neglected, and that the river and hill stream channels which have head sluices are ill-provided with subsidiary arrangements, and are generally in bad condition. There are 3,000 irrigation works on the register (exclusive of those in the Kimedy estate), many of which, however, are not worth keeping up. It is proposed, as a general measure, to provide the more important works with rough escapes, sluices, &c., as cheaply and quickly as possible.

4. Such measures based in every case on a clear knowledge of the conditions and the return of revenue for the expenditure to be incurred are doubtless what are required, but the works though numerous are for the most part of insignificant individual importance, and their *raison d'etre* depends on very economical conservancy.

5. VIZAGAPATAM.—The damage to works in the Vizagapatam district does not appear to have been of any great importance. As in Ganjam, those for irrigation are of a petty nature and the estimated cost of repairs only amounts to Rs. 7,000. The bursting of tanks caused injury to a number of roads, and to make this good Rupees 6,858 will be required. The whole outlay on account of floods in this district will apparently not exceed Rupees 14,000.

Damages of a petty nature.

Repairs to Tanks, &c., Rupees 7,000.

To roads, Rupees 6,858.

The District Engineer has hardly touched on the question of the measures required to prevent disasters in future except as regards damage to roads. In reference to this he suggests that all proprietors of tanks should be required to provide calingulahs, or that they should be held responsible for the consequences when they do not do so. Instructions have been issued on this subject to District Engineers, who are directed to examine into the circumstances of each private tank, to draw up the necessary instructions for putting them into a secure state, and also on the requisition of owners of tanks to prepare surveys, plans, and estimates for carrying out the necessary works, as well as to carry out the same at the cost of the persons concerned.

Private tanks.
Responsibility of owners.

6. Allusion is made to the breaching of two irrigation channels for which repair estimates have been prepared, but it is probable that additional works are required for regulating the supply and thus avoiding a recurrence of the damage.

Kristamraz and Pulapurty.

7. KISTNA.—The effect of the floods in the Kistna on the delta works was disastrous. The report of the District Engineer which describes the damage in detail will be found in the appendix.* The river rose on the 26th September 1874 to a height of 19 feet 5 inches above the crest of the anicut, which itself is 20 feet above the bed of the river. This is 11 inches higher than any previously recorded flood.

Flood of September 1874.

* B.

Height of flood at anicut.

8. The Kistna river is confined to its course by embankments which extend on the eastern or left bank from a point some nine miles above the works at the head of the delta to the island of Divi, and on the western side from the head works to the sea. Both were breached at points below the anicut, and the flood water spreading over the delta on either side burst into and submerged the canals* which traverse it and filled and breached the tanks. There were numerous breaches in the canal banks, and a large quantity of silt was deposited on the main canal. The repairs immediately necessary will cost, it is estimated, Rupees 90,000, of which Rs. 30,000 will be required for the river embankments, Rupees 50,000 for the canals, and Rupees 10,000 for the removal of silt.

River Embankments.

Breaches and injury caused.

* Masulipatam Canal. } Eastern Delta.
West side Channel. }
Bank Canal. }
Nizampatam Canal. } Western Delta.
Iskapully Channel. }

Repairs Rupees 90,000.

9. The measures necessary to guard against disaster in the future are to a certain extent indicated by a consideration of the circumstances noted during the continuance of the flood. The head works were nearly submerged, and it is proposed to raise them two feet. The river embankment above the anicut was in great danger of being overtopped. Those below were so. The Divi island embankment was also injured. It is proposed to raise all these from 2 to 3 feet at a cost of a lakh of Rupees. The villagers living on the land between the river embankment and the river bank itself, there is much reason to believe, cut the bank in several places when the river rose with a view to saving their own tenements, by allowing the water to spread and thus lowering its general level. It is proposed to induce these people to move to the outside of the embankments, by allowing them free building sites, thus giving them an interest in the preservation of the protective works.

Measures necessary for future safety.

Head Works.

River Embankments, Rs. 1,00,000.

10. NELLORE.—It was in the Nellore District, in the valley and delta of the Pennair river, that the effects of floods were most severely felt. A detailed account of the damage sustained by the various works of irrigation, the roads, &c., written by the District Engineer, will be found appended hereto. The river is confined to its course within narrow limits on the left or northern bank by high land as far as Sungum, a point 35 miles from the sea, below which spreads the northern delta. On the southern side the high ground extends several miles lower and prevents flood water from spreading to any great extent. It was therefore below these points on the river that the damage to the country chiefly occurred. The river commenced to rise on the 25th October, and attained its maximum height of 18 feet 4½ inches on the crest of the anicut at 8 o'clock on the morning of the 26th, continuing at that level till the evening, when it commenced to subside. The level reached was 2 feet 10½ inches above the highest flood previously recorded, but of course the afflux caused by the anicut must be taken into account.

General description of river Pennair.

Appendix C.

Maximum height of flood.

11. The Nellore anicut which is placed across the Pennair, near the town of Nellore, was extensively injured. It was turned at its northern end, the wings were carried away and the body of the work adjoining was undermined and destroyed. Scour along the face caused a slight subsidence of another portion, and the rear slope was partly torn up and carried down the stream. The loose rubble apron subsided about 1½ feet throughout. The river embankment on the right side above the anicut was breached in three places, and the town of Nellore was flooded by the escaping water, houses and huts were destroyed, but no lives were lost. After sweeping through the town the water reached the western spoil bank of the Survapully channel, overtopped and carried part of it away and poured down the channel bed, which with the banks was much injured. The

Nature of damage to works, southern bank, Nellore Anicut.

River Embankments.

Survapully Channel.

flood bank between Narisimuluconda and the Nellore anicut also gave way, and this involved the overflow and breaching of the large Nellore tank.

Nellore Tank.

12. On the north side of the river the results of the flood were similar. At Sungum a portion of the Gandaveram head sluice was destroyed, and the Pennair breached into the Duveru tank supply channel. Between Sungum and the sea 153 square miles of the northern delta were submerged, much property was destroyed, and crops were under water for several days. Thirty tanks were breached, the Cuddapah and the great northern road were cut and otherwise injured for miles, and the bridges partly destroyed. One rest-house was entirely swept away.

Northern bank.

Gandaveram head sluice.

Country submerged in Northern Delta and tanks breached.

Above Sungum, on either bank, the roads to Cuddapah and the Somaishwaram gorge were partly washed away, and the embankments of a few tanks were breached. A considerable quantity of land on the margin of the river was eroded.

Damage to roads.

13. The cost of the repairs immediately required is given in detail in the statements which accompany the District Engineer's report. It amounts to Rupees 3,09,910 distributed as shown below :—

Cost of repairs, Rupees 3,09,910.

	Rs.
Tanks	57,400
Embankments	9,000
Channels	32,050
Roads	46,500
Anicut	1,64,960

The charge for the anicut includes lengthening 450 feet at the northern end.

14. The works required to secure the delta from inundation are estimated to cost Rupees 2,89,000. They consist simply in the extension and raising of the existing river embankment on the south side, and the construction of a similar work on the north; Rupees 85,000 being allotted for the former, and Rupees 1,98,000 for the latter work. Rupees 2,000 are allowed for the planting of nanel grass as a security against erosion. The embankment on the right bank of the river will be 22½ miles in length to the sea, from 10 to 8½ feet above the country and 4½ feet above flood level. That on the left bank from Sungum to the sea will be 33 miles in length, 10 feet above the country and from 4½ to 6 feet above flood level.

Cost of improvements, Rupees 2,89,000.

15. KURNOOL.—There appears to have been exceptionally heavy rain in the Kurnool district during the months of July, September, and October, and tanks and roads sustained considerable injury. Twenty-seven of the former were breached and three damaged. The cost of the repairs is estimated at Rupees 22,000 for tanks and Rupees 30,450 for roads, and for preventive measures in regard to tanks, Rupees 59,600.

Rains of July, September, and October 1874.

Nature of damages.

Cost of repairs, Rupees 22,000.

Cost of improvements, Rupees 59,000.

16. CUDDAPAH.—The effects of the floods in the Cuddapah district were serious. The rainfall during the months from May to October was largely in excess of the average, and in fact exceeded the usual amount for the whole year. The tanks were all full by the end of September, and although the slight fall at the commencement of October did no harm, the downpour between the 20th and 26th of that month was for the most part at once surplused over the weir and discharged into the water courses, and channel-fed tanks were exposed to sudden in-rushes of water which in a number of instances sufficed to breach them. The following is a statement of the rainfall (during the period from the 20th to 26th October) which was the immediate cause of the damage.

Rainfall excessive, May to October 1874.

Date.	Jammalmadgoo.	Proddatore.	Budvail	Sidhout	Pullumpett.	Cuddapah.	Poolivandula	Royachoty.	Voilpaud.	Madanapully.	Kodair.
	Settivaripully.	Nundilumpett.	Budvail.	Wontimitta.	Pullumpett.	Cuddapah	Vaimpully.	Guvulcheruvu.	Peelair.	Madanapully.	Kodair.
20th	1·15	0·35	...	...	...	0 05	...	...	1 00	...	0·25
21st	...	0·25	0·65	...	...	0 05	...	...	0 05	2·85	0·15
22nd	...	2 00	0·15	...	0·40	0·05	0·65	0·11	0·60	0·40	0·20
23rd	1 90	1·10	2·85	3·50	5·25	2·45	0·65	3·10	3·30	0·90	0·65
24th	0·60	3·50	1·05	3 80	10·45	3·75	1·60	5·60	5·50	3·40	3·00
25th	1·40	0·50	3·40	6·60	7·25	5 60	1·70	4·70	5·00	2·25	3·15
26th	0·10	...	0·15	0·45	0·68	0 40	2·20	0·30	1 70	0·45	1·00
	5 15	7·70	8·25	14·35	24·03	12·35	6·80	13·81	17·10	10·25	8·40

The rivers fed by drainage, which ran rapidly off the already saturated country, rose to unprecedented heights and overflowed the banks natural or artificial. The railway which traverses the district was breached in several places, and the roads were flooded and injured. The Pennair river runs through the northern part of the Cuddapah District in a direction from north-west to south-east and is joined in its course by two considerable rivers, the Cheyair to the south and the Paupugnee to the north; these receive the drainage of nearly the whole district. The tributaries of the Cheyair, *viz.*, the Goojna, Poolunga, the Panchoo, Bauhoo and Nundayur Nadee, were all in high flood, and the Cheyair rose accordingly. Its drainage area is about 2,200 square miles, and the valley in which it runs opens out about 4 miles above the point where the Madras Railway crosses it. Here it is embanked and the water broke through on both sides, on the north flooding the country for a mile in breadth, and on the south breaching the railway embankment. A mile below the railway bridge the hills close again on the river on the south side and confine it to its course for a short distance, but below this as far as Pennagalur, a distance of 12 miles from the bridge on the south side and down to Coorcoutpullay near the junction of the Cheyair and the Pennair on the north, the embankments have been almost entirely destroyed, the irrigation channels obliterated, and the tanks in the margin of the river breached.

Nature and extent of damage.

Hydrography of the district.

The Cheyair River.

Embankments breached and railway damaged.

17. In the upland taluqs drained by the tributaries of the Cheyair already referred to, the Government tanks as a rule stood the strain on them well. The weirs and their aprons were damaged more or less by the large volume of water pouring over them, but this was no more than might have been expected. The Munnoor Kitchema near Rajampett, the Chittoor tank about 9 miles north of Royachoty, and the Peddanair Calva Iyavari tank were however breached. In the first case the failure which involved the destruction of a portion of the railway was owing to the insufficient length of the surplus weir. In the second, the damage was caused by the breaching of seven small tanks above the large one, and in the third the bank gave way apparently on account of its faulty internal condition. In the accounts furnished mention is made of various other minor works in this part of the district which were injured or destroyed, but which it is unnecessary to notice here in detail.

Damages in upland taluqs.

Tanks breached.

18. The Paupugnee river in its course through the district of about 75 miles receives the drainage of the greater part of the Madanapully taluq and portions of the Kadiri, Royachoty, Pulivendla and Cuddapah taluqs. Five small tanks in the Madanapully taluq were breached, and the weirs of thirteen were damaged. In the Kadiri taluq a rough stone anicut across the river and the supply channel from it were injured. In the Cuddapah taluq the Paupugnee destroyed great part of the head sluice to the supply channel of the Camalapore tank, filled the channel with sand, breached the tank and carried away a travellers' bungalow on the left bank of the river. The Jammalmudgoo Taluq, in the extreme north-west of the district, is traversed by the Pennair river. Here the Chintacoonta tank burst. It had no surplus escape and had never before been in need of one, but on this occasion the supply was in excess of its limit of safe capacity and the bank gave way. The discharge washed away the earthwork of the railway more or less for a length of 4 miles. The Pennair was in high flood, and passing round the village of Chennoor breached the trunk road; below Sidhout the country was flooded, but little damage was done. The injury to works in the Poddatore and Budvail taluqs was of no great importance.

The Paupugnee river.

Damages on its course.

Camalapore supply channel.

The Pennair river, damages caused by it.

19. The District Engineer sums up the cost of repairing the damage at Rupees 1,80,400, distributed amongst the several taluqs as follows:—

Summary of the cost of irrigation repairs in the Cuddapah District, Rupees 1,80,400.

	Rs.
Pullumpett	1,00,000
Voilpaud	4,000
Madanapully	8,000
Royachoty	20,000
Kaderi	6,000
Cuddapah	3,300
Jammalmudgoo	30,000
Poddatore	2,800
Budvail	2,500
Sidhout	1,400
Pullivendlah	2,000

But this, it is stated, only refers to irrigation works; the injury to Local Fund works is estimated at Rupees 30,000 in addition, and the amount allotted to the former does not include the outlay necessary for raising the Cheyair embankments and constructing head sluices so as to render them safe for the future. Surveys and estimates for this work are in progress. It is presumed that the estimate for the repairs to the other irrigation works is based on a consideration of their requirements, and that these again are calculated on the supposition that the works are to be made safe for the future.

Local Fund Works repairs, Rupees 30,000.

20. Bellary.—Although the rainfall at the latter end of October appears to have been very heavy in the Bellary District, the damage to the irrigation works was not remarkably great. Three of the largest tanks in the district, however, gave way at their calingulahs, and a number of minor works sustained injury of lesser importance. All the necessary repairs could, it was stated, be executed from the current allotment.

Damages of slight importance.

21. Chingleput.—The District of Chingleput was visited with severe floods in 1874, and it had previously suffered from the same cause in 1872. The damage during the former year appears to have occurred chiefly in the month of October. An abstract of the list of injured works furnished by the District Engineer shows the following result:—

Floods of October 1874.

Summary of works injured.

	Rs.
Tanks breached	259
Supply or river irrigation channels breached	10
Sluices, anicuts, or waste weirs destroyed or damaged ...	9
River embankments breached or washed away	6

Cost of repairs, Rupees 98,598.
Improvements, Rupees 2,98,220.

The cost of repairs is estimated at Rupees 98,598, and that of securing the works against similar damage in future at Rupees 2,98,220.

The cost of repairs to roads is not included in the above estimate.

22. The principal streams draining the district commencing from the north are the Narnaveram, the Corteliar, and the Palar. The lesser independent lines of drainage to the sea being the Cooum and the Adyar. It is stated by the District Engineer that since the period of the great floods of 1857, the river embankments in the northern part of the district had been much neglected and tampered with for private purposes by the villagers, who cut gaps in them for irrigation purposes. The channels leading from the rivers are often unprovided with sluices at their heads to regulate the passage of the water, and this circumstance combined with the spill from the streams when in extraordinary flood over or through the embankments led to the overfilling and breaching of tanks, the destruction of waste weirs and channel banks, and, in fact, to most of the damage which is reported to have occurred. In other parts of the district the injury to tanks was the result of neglect of the bunds or masonry works, and the insufficiency of the provision for the discharge of surplus water. The flood in the Corteliar resulted in injury to the anicut at the head of the channel supplying the Madras Water Works, and the embankments of the river and channel were breached. The anicut on the

General state of agricultural works prior to the flood.

Corteliar river.
Anicuts damaged.

same river at Kasaveram was turned. The Chingleput taluq suffered chiefly in the neighbourhood of the Palar. The Madranticum tanks are said to have been injured by the bursting of those in North Arcot, situated on the same drainage lines.

23. North Arcot.—The Palar river traverses the southern part of the North Arcot District. Its principal tributaries in this part of its course are the Goriattum and the Poiney on the north, and the Cheyair on the south. The district was visited with heavy rain at the end of October 1874, all these rivers were in high floods, and the damage to various works and to the district was serious. Half of the large anicut across the Palar near Arcot was carried away, and nearly the whole of the Poiney anicut disappeared. The similar work on the Cheyair was injured. The Poondy large tank near Wallajahpett was breached by the overflow from the Palar and the Poorsay tank, which is supplied by a channel from the Cheyair, was topped by the water which scoured away a considerable portion of the bank without actually breaching it. One hundred and twenty works of minor importance were injured. The above refers to the damage to irrigation works, but others did not escape. The Palar bridge between Vellore and the Railway station gave way for a length of 230 yards. The Goriattum bridge, on the road from Palmanair to Bangalore, was swept clear at its upper part. The arches and piers only remaining and the embanked approach was breached. The communication in the greater part of the district suffered severely owing to the overflow of the Palar and Cheyair. The District Engineer has not proposed any specific alterations to works, or any provision tending to greater security in the event of floods, but states that the embankment of the Palar is a matter for consideration. Some short embankments on the left side above the Palar anicut, which will prevent the head sluices being turned will, however, at once be carried out. The cost of the repairs to the irrigation works is estimated at Rupees 2,09,000 and for others Rupees 1,46,000. So far as the Government land is concerned, the flood will render necessary an expenditure of Rupees 3,55,000, but this estimate takes no account of the injury and loss in the Zemindaries or private estates, which constitute more than half the area of the district. It is stated to have been extensive, and that evidence of it is afforded by the unprecedented flood in the Goriattum river, which was caused by the sudden release of water in consequence of the breaching of numbers of private tanks. Appendix D. gives further particulars on this subject.

Floods of October 1874.

Damages.

Palar anicut breached, Poiney anicut destroyed, Cheyair anicut injured.

Palar bridge.

Communications.

Cost of repairs, Rupees 2,09,000 for Irrigation Works, Rupees 1,46,000 for others.

24. South Arcot.—The principal streams draining the South Arcot District are the Pooniar or Panar and the Vellaur. Both are largely utilized for irrigation in the usual manner by anicuts or weirs feeding artificial channels, which irrigate directly or supply tanks and by other channels kept up by the native cultivators having their heads in the bed of the rivers, but unprotected by sluices. The Pooniar is also embanked at certain parts of its course, but the embankments, as in the case with most of the works of irrigation, were in a state of disrepair. Unusual rainfall causing

The Pooniar and Vellaur rivers.

Embankments of Pooniar.

an abnormally high flood in the Pooniar resulted naturally in considerable damage to these works which were on its course or connected with it. A cyclone which visited the district in May, and heavy rains in September and October, produced severally a catalogue of disasters. The Pooniar anicut was damaged on the first occasion, as were also the supply channels leading from it, the head sluice on the north being completely destroyed. The repairs were interrupted and the damage was extended by freshes in September and October. The Teruvady anicut on the Guddilum was also damaged by the cyclone. The Corryaur embankment on the Pooniar was in like manner washed away in May, breached again in September while repairs were in progress, and almost entirely destroyed again in October. The bridge across the Pooniar at Munjacoopum was seriously injured.

Damage by cyclone of May 1874, and rains of September and October 1874.

25. Of minor irrigation works the rain-fed tanks suffered not at all, but the heads of every channel along the Pooniar were more or less destroyed, and thirty-nine channel-fed tanks were breached. Almost the whole of the Pooniar river embankments were washed away. The damages to roads are estimated at Rupees 80,000. In addition to the repairs essentially necessary, the District Engineer's recommendations involve the provision of head sluices to the river channels and the embankment of the Pooniar river from its mouth for a distance of 50 miles on either bank. The expenditure necessary or in prospect is summarized, below :—

Rain-fed tanks escaped.

Supply channels from the Pooniar and channel-fed tanks injured.

Summary of expenditure required.

	Repairs.	Improvements.
	Rs.	Rs.
Irrigation works	2,09,000	35,000
Embankments	...	3,30,000
Bridges	43,000	...
Roads	80,000	...
	3,32,000	3,65,000
Grand Total ...	6,97,000	

26. Salem.—In the Salem District the damage by heavy rain in September and October 1874 was confined to the northern portion comprising the Oossoor and Tripatore ranges, and it was trifling in extent, ten tanks and two anicuts were breached. It is gathered from the District Engineer's report that the cost of repairs would not exceed Rs. 2,000 and the improvements alluded to as necessary amount in the aggregate to about Rupees 1,500. This district however suffered seriously from previous floods, and a great deal of the damage done remains to be made good.

Floods of September and October 1874.

Cost of repairs and improvements Rs. 3,500.

27. Tinnevelly.—The north-east monsoon burst in this district on the 26th November, and produced a flood in the Tambrapurni, the principal river, which caused extensive damage. The rainfall on the 26th and 27th November varied at different localities from 12 to 6·8 inches. The rise in the river was somewhat less on the whole than on the occasion of the previously recorded inundation of 1869.

Flood in the Tambrapurni.

The irrigation works deriving their supply of water from the river suffered in the usual manner and from the usual causes.

Damage to irrigation works on the course of the river.

Supply channels, whose heads were unprovided with sluices to regulate the influx of river water were flooded, breached and silted up, and the water finding its way into the tanks which these channels supplied in several instances caused their destruction also. The provision made for passing the drainage of the country across these channels proved in certain cases to be insufficient, and the channel banks were carried away in consequence.

As in the case of Kistna, the Cheyair and the Palar, under similar circumstances, already described, the Tambrapurni overflowed its natural banks and breached the artificial embankments raised to confine it.

River embankments breached.

These have proved to be both too low and too weak to withstand the stream brought to bear on them on such occasions. The water having once penetrated into the low lands adjacent to the river proceeded to find its way to lower levels, washing away roads and destroying channels and tanks in its course.

The details of the damage are fully described in the report of the District Engineer recorded under G. O., No. 256, of the 29th January 1875. And the further account appended hereto gives other particulars, and describes the measures which it is proposed to take to prevent similar disasters in future.

Appendix E.

28. There are five old irrigation channels of considerable importance which branch off from the river at points above the town of Tinnevelly, and depend for their supply on native anicuts on the river. There is also one anicut just below the junction of the Chitaur with the Tambrapurni, 28 miles from the sea, and another recently completed at Streeviguntum about 15 miles from the sea. Both of these works feed channels on either bank of the river. The upper anicut, the Mardur Melakal channel on the west or right bank, and the Kilakal on the left bank. The lower work is connected with the north channel on the left bank and the south channel on the right. The river is at present embanked on both sides, from Autur at the embouchure to Manakari on the left bank, and Karangkulam on the right bank, or about 18 miles from the sea.

Mardur Anicut.

Streeviguntum Anicut.

Supply Channels.

Measures have already been taken to provide the five channels above Tinnevelly town as well as the Mardur Melakal below it with head sluices. Generally it may be said that all these channels require considerable improvement. Their banks need in many cases to be raised to exclude river water, the surplus weirs provided have proved often of insufficient length to pass off the drainage crossing them and extensions are required. In other cases they have been topped by the river flood and their action reversed, and there have resulted extensive breaches from these and similar causes. The non-existence of sluices to the Kodagan and Tinnevelly channels caused the flooding of the town of the latter name and considerable damage to property. The same observations apply to the channels taking off from above the Mardur anicut, and in a less degree to the north channel from the Streeviguntum anicut.

Defects in the existing channels.

29. A number of tanks surplusing into each other, and, finally, across the channels above referred to and into the river, require attention. Some have been breached owing to insufficient provision of escapes. The river embankments require to be raised, strengthened, and extended, for they were not only breached where they now exist, but flood water escaped in other parts. It is proposed to carry them up on the left bank to the west of Sivalaperi, and on the right bank they will be raised from Kairangcolum to Autur to a height varying from $4\frac{1}{2}$ to 6 feet above the flood level of 1874.

Defects in tanks and river embankments.

30. The expenditure which will be necessary to carry out the repairs and improvements to the works in the Tinnevelly District is given in full detail in the accompaniment to the District Engineer's letter which will be found appended. It amounts to Rupees 2,20,840, of which Rupees 42,500 will have to be devoted to the first object and Rupees 1,78,340 to the second.

Expenditure on repairs, &c., Rupees 2,20,840.

Appendix E.

31. The reports from districts other than those above referred to show that they were not visited by rainfall or floods of an unusual character.

32. The foregoing narrative, compiled from the district reports, shows that there was considerable variation in the extent of the floods, and consequently in the damage sustained in the various districts, and in fact that it was only in the Kistna, Nellore, Cuddapah, Chingleput, North and South Arcot and Tinnevelly Districts that extraordinary effects resulted.

Concluding observations.

The floods partial in their effects.

33. The following is a summary of the cost of repairing the damages to irrigation and, as far as it has been ascertained, to other works in districts where there has been exceptional rainfall. The cost of the improvements to existing works or of such new constructions as are considered desirable is also stated:—

Summary of cost of repairs.

	Emergent Repairs to Irrigation Works.	Improvements to Irrigation Works required.	Damage to Roads, Bridges and non-irrigation Works.	Total ascertained damage to Public Works.
	Rs.	Rs.	Rs.	Rs.
Ganjam	10,000	60,650	2,000	72,650
Vizagapatam	2,885	4,115	6,858	13,858
Kistna	90,000	1,02,000	18,120	2,10,120
Nellore...	2,63,410	2,89,000	46,500	5,98,910
Kurnool	22,000	59,000	30,450	1,11,450
Cuddapah	1,80,400	1,20,000	30,000	{probably 3,30,400 3,96,818
Chingleput	98,598	2,98,220	...	
Bellary	Repairs executed out of current allotments.			
North Arcot	2,09,000	Not stated.	1,46,000	3,55,000
South Arcot	2,09,000	3,65,000	1,23,000	6,97,000
Salem	2,000	1,500	...	3,500
Tinnevelly	42,500	1,78,340	Not stated.	2,20,840
Total ...	11,29,793	14,77,825	4,02,928	30,10,546
	26,07,618			

It will be observed that the total cost of the repairs to irrigation works is estimated at Rupees 11,29,793, and the proposed improvements will cost Rupees 14,75,825. The expenditure required on improvements only partially exposed. Thus an outlay is foreshadowed of Rupees 26,05,618 chargeable against the resources available for Public Works expenditure on irrigation works, and the bulk of this expenditure is confined to the requirements of seven districts only. It is a fact to be noticed also that the exceptional rainfall in most cases only affected portions of the districts referred to, and that consequently a mere percentage of the irrigation works was subjected to extraordinary strain. The deduction is that similar floods in other districts or in other portions of these same districts would demonstrate the need of more extended expenditure.

34. The disasters which have occurred have almost all originated from the overflowing of the rivers, whose banks, natural or artificial, proved insufficiently high or strong to retain them. The irrigation or tank feeding channels leading from these rivers were in most cases unprovided with sluices to control the entry of flood water. They were submerged and destroyed, the tanks they fed were filled to excess, and being often ill-provided with escapes gave way, and their ruin led to that of others lower down. In short, the natural hydrography of the country has been largely interfered with, and an artificial drainage system has been established which does not provide for abnormal conditions, conditions which however recur unfailingly at intervals more or less great. That the rainfall during the months of May to October 1874-75 was generally of a very exceptional character is shown by the following statement, which compares the average for the several districts with the fall during those months of 1875 :—

Immediate cause of the disasters; the same generally.

Rainfall, May to October 1874.

	Rainfall in six months, May to October.	
	Average of four years previous.	1874-75.
	Inches.	Inches.
Ganjam	39·02	41·90
Vizagapatam...	36·57	37·08
Kistna	23·52	32·80
Nellore	23·63	35·22
Chingleput	27·58	51·90
North Arcot	28·06	51·22
South Arcot	27·35	39·32
Bellary	21·13	38·09
Cuddapah	21·59	49·17
Kurnool	23·96	48·59
Salem	28·09	38·54
Tinnevelly	7·15	7·32

It is not at all probable that any arrangements which can be made will certainly and at all times prevent loss from extraordinary floods. The histories of the Po, the Rhone, the Loire, and the Garonne and other rivers in Europe show how difficult it is to deal effectively with and control the drainage of a country, but much may be done to ameliorate matters, and in no branch of engineering are successful operations more

immediately and largely productive of good than in that connected with the improvement of rivers.

35. The propositions made by the District Engineers in this direction involve the construction of embankments or the extension of those already existing on the courses of the Kistna, the Pennair, the Cheyair, the Palar, the Pooniar, and the Tambrapurni, and the provision of sluices to the heads of the channels taking off from these rivers for purposes of irrigation. The details of such embankments will depend, as will their successful application, on a careful study of the *regime* of the several rivers, their surface levels during flood at all points, and the effect of the proposed embankments themselves in increasing the flood level, a knowledge of the flood discharges is therefore necessary, and, considering the complications introduced by the bursting of embankments and the consequent expansion of the waterspread during the most critical period, it is by no means easy of attainment. The work to be done is extensive, and very careful adaptation of the means to the end is necessary in each case.

General propositions of District Engineers for the improvement of rivers.

36. The improvement of the existing irrigation works. The provision of sluices and escapes to tanks and of similar work to channels with the object of enabling them to pass the surplus drainage of the country has also been suggested, and works are being carried out while estimates for others are in course of preparation.

Nature of improvements generally required to irrigation works.

(Signed) JOHN MULLINS, Lieut.-Colonel, R.E.,
Chief Engineer for Irrigation.

20*th September* 1875.

APPENDIX A.

From Major H. SMALLEY, R.E., Officiating District Engineer, Ganjam, to Lieutenant-Colonel J. MULLINS, R.E., Chief Engineer for Irrigation, dated Camp at Bagada, 11th February 1875, No. 14.

With reference to G.O., dated 4th December 1874, No. 3,411-A,* I have the honor to report on the damages done to Irrigation Works in this district by the late heavy rains during October and November last, as follows, *viz.* :—

* Your memorandum, No. 1,038, of 11th December 1874.

	Estimate Cost of emergent Repairs.	Conjecture Cost for putting the Work into thorough order.
Berhampore Taluq.		
River Embankments.	Rs.	
Bahuda river embankment breached in three places, at Bellupada, Eadupore and Loddaputty.	556	Rs. 10,000 for embanking the whole length in Government limits, partly new work, partly repairs.
Channels.		
1. Jamily branch of Jeyamangalum channel, breached.	200	Rs. 1,000 for head sluice to channel and repairs.
2. Regulating sluice of Koratholy Tampara, destroyed.	300	Rs. 3,000 for new sluices, extending weir, repairs to head sluice and tank.
3. Koratholy Tampara sluice foundations, undermined.	200	

	Estimate Cost of emergent Repairs.	Conjecture Cost for putting the Work into thorough order.
Tanks, breached.	RS.	
1. Kodasinge Mansingighayee and Ambaghayi...	176	Rs. 500 for weirs and sluices.
2. Bodabandho, Ramasageram, Goyye, Ghayi of Umpoova.	390	„ 1,000 for do. do.
3. Deepalaghayi and Voora Cheroovoo of Karapadu.	82	„ 500 for weirs, sluices, and repairs.
4. Bodobandho Hozo of Randha and Bodabandho.	93	„ 750 for head sluice, escape sluices, and repairs.
5. Rajaghayi of Kedapooram	43	„ 200.
6. Jabbooroo Cheroovoo of Manigapooram ...	38	„ 200.
7. Rajah Cheroovoo of Balliagada	33	„ 200.
8. Hozo Tank of Lanty	102	„ 1,000 for weir and sluices.
9. Hetha Nalla of Moheghayi	72	„ 200.
10. Korta Cheroovoo and Thalanoyi of Bendalia...	254	„ 10,000 for repairs of Jayamungalam channel and river embankments.
11. Mussaghayi of Korada	21	...
12. Kareghayi of Deppenowpada	77	Rs. 2,000 for repairing banks of whole stream in Government limits.
13. Pudmapooram gedda of Toolasigam	122	...
14. Durmapooram Geddaghayi	60	Rs. 500 for weir, sluices, and repairs.
15. Gungu Sagaram and Hetta Sagaram of Bagala.	210	„ 500.
16. Sanbandho of Soonadahara	44	„ 200.
17. Rajah Sagaram of Nimmapalli	48	„ 200.
18. Kudumsagaram of Banbanda and Voosamatia Badabandho.	262	„ 500.
19. Kunchera Kopa Mundalesuaraghayi	200	„ 1,000 for improving weir and repairs.
20. Benaghayi and Bavunghayi of Luchapada ...		„ 1,000 for weir and sluices.
21. Ballikya Tampara and Mandoova Cheroovoo of Bohiligam.		„ 1,000.
22. Borigam Bodabandho and Jameegandybandho.		„ 500.
23. Koratholy Jaladaraghay		„ 300.
24. Tank of Banginbady		„ 300.
25. Tank of Bahulajholly		„ 300.
26. Tank of Bagagherry		„ 300.
27. Three tanks of Pulta	500	„ 1,000 for weir head sluice and repairs.
28. Bodabandho of Pata Chetterpore	100	„ 200 for lowering weir and repairs.

Estimates framed. Revenue details under discussion. Work being done on emergency.

GUMSORE TALUQ.

Nil.

CHICACOLE TALUQ.

Channels.

1. Nagaricatacum channels cross bund, breached.		Rs. 500 for revetments.
2. Nowry channel and its branch dam, breached.		„ 500 for head sluice and repairs.
3. Byree channel head sluice damaged... ...		„ 500 for revetments.
Aqueducts.		
1. Lutchmipooram channel of Nagricatacum aqueduct, injured.		„ 1,000 for rebuilding aqueduct.
2. Sagaramgedda do.		„ 200

Estimates not received from the Range Officer, but the work being carried out on emergency.

	Estimate Cost of emergent Repairs.	Conjecture Cost for putting the Work into thorough order.
Bridges.		
1. Bridge of Kaliveram Dusi channel, injured...		Rs. 100.
2. Wooden bridge of Vunjangy		„ 100.
3. Do. do. of Nelliparti Dusi channel ...		„ 100.
4. Turkapeta bridge, Dusi channel, head railings, fell down.		„ 50.
Tanks.		
1. Ragoloo Cheroovoo of Borigavalsa, breached ...		„ 250.
2. Gungulavany Cheroovoo at Kaliveram, breached.		„ 500.
3. Dusy Pedda Cheroovoo, breached		„ 500.
4. Toolooga Mustakan Cheroovoo, breached ...		„ 250.
5. Tuticulam at Audavaram, breached		„ 250.
6. Ninda Cheroovoo of Chennapore, breached ...		„ 250.
7. Makivalsa Calingulah, damaged		„ 200.
8. Syregam do.		„ 200.
KIMEDY ESTATE.	RS.	
Channel.		
1. Buttisiripooram Anicut channel, breached ...	167	„ 10,000 for completing project.
Hill Streams.		
1. Navagam Munipadigedda head sluice, damaged.	167	„ 500 for revetments.
2. Calivagedda Calingulah damaged and breached at Jaepore.	134	„ 500.
Tanks, breached.		
1. Kimedy Seetasagaram tank	38	„ 1,000 for improvements.
2. Thooroopoo Neelacantapatruny tank	213	„ 500.
3. Mahasingi Rajoo tank...	106	„ 250.
4. Labhara Nalla tank	208	„ 500.
5. Tembore Sunnapaghayi tank	176	„ 500.
6. Saravacota Rungasagaram	115	„ 2,000 for subsidiary works.
7. Saravacota Gajapatisagaram tank	41	„ 200.
8. Varanasy Godalavany tank	73	„ 200.
9. Balada and Matala Cavulagedde	148	„ 400.
10. Sarvakota Codandapanasa Voora tank ...	44	„ 200.

Estimates not received from the Range Officer, but the work being carried out on emergency.

2. The damage done to the Irrigation Works in this district by the last rains has not been so great as in last year, the rain having fallen during a longer period. The damages done have been chiefly to works near the coast. The river freshes in the north of the district were not severe, but in the south they were higher than known within recollection. The rainfall on the coast was higher in the northern than in the southern portion of the district. A very small percentage of the tanks is provided with masonry works of any kind; very few have both sluices and escapes or head sluices. River embankments generally have been much neglected hitherto. The river channels that have head sluices are altogether deficient in subsidiary arrangements, and are quite out of regimen. The hill stream channels are in the same condition.

3. There are about 3,000 Irrigation Works in the irrigation register, exclusive of Kimedy, and to supply all these with regulating works would take an immense time, besides which many of them are not worth keeping up. The only thing to be done seems to provide rough, but strong, escapes, sluices, &c., as cheaply and quickly as possible to the more important works beginning inland and working towards the east.

APPENDIX B.

From Major J. O. HASTED, R.E., Superintending Engineer, 1st Division, Kistna, to Lieutenant-Colonel J. MULLINS, R.E., Chief Engineer for Irrigation, dated Masulipatam, 11th January 1875, No. 136.

WITH reference to G. O., No. 3,411-A, dated 4th December 1874, I have the honor to report on the floods of September 1874, as follows:—

Date of flood.

The flood occurred from the 26th to 29th September 1874 at a time of the year when the river is generally low and the freshes of the south-west monsoon are supposed to be over; the registers of former years show that there is usually a lull between the south-west and north-east monsoons, and during this interval the river is liable to fall so low that there is a difficulty in taking off a sufficient supply for irrigation, the last few years, however, have been exceptions to this rule.

Period of low water in river.

2. On the 23rd night the river stood at a little over 6 feet on the crown of the anicut, the water rose steadily all the 24th, and on the evening of that day was 14 feet 9 inches above the anicut, on the 25th morning it was 16 feet 11 inches. Evening 18 feet, 26th morning 18 feet 8 inches. Evening 19 feet 5 inches the maximum registered; it remained at about this height for a considerable time, the register showing 19 feet 2 inches. On 27th evening and all the 28th the same height; on the 29th morning it had fallen to 18 feet 10 inches, and by evening to 17 feet 8 inches. 30th morning to 15 feet 5 inches, and after that it fell steadily till the 10th October, when it was below 5 feet on the anicut. The crest of the anicut is 20 feet above deep bed of river.

Registered heights of flood.

Maximum, 19 feet 5 inches + anicut crest.

Level of anicut crest + 20 feet.

3. The season for high freshes is usually in July and August, and the greatest heights registered since the anicut was built was 17 feet 3 inches above the crest of anicut; this height was attained in July 1859 and August 1868.

Greatest previous height above anicut, 17 feet 3 inches + anicut crest.

Before the anicut was constructed, however, in July 1853, a very heavy flood occurred which was registered at 37 feet 9 inches, or 17 feet 9 inches above the present level of the anicut. I calculate that the level of the water would have been raised very little more than 9 inches by the construction of the anicut, or that the flood of 1853 was equivalent to a flood of 18 feet 6 inches above the anicut. The flood of 1874 was, therefore, 11 inches above the highest flood previously recorded.

Greatest height before anicut was built, 17 feet 9 inches + anicut crest.

Height due to obstruction of anicut, 9 inches.

4. The damage done to the head works was very trifling, though the water rose about 6 inches above the roadway of the bridge over the head sluices to the Eastern Delta and submerged the nose wall of the boat chamber above the head lock. The workshop yard was partly submerged and water entered the District Engineer's Office. To guard against danger from high floods in future, I think the head sluices and upper walls of locks should be raised 2 feet, which would give a margin of about 1 foot 6 inches above highest flood level, and allow for even a higher flood than 21 feet on the anicut, as the parapet walls are very massive and would withstand, as they did this flood, a considerable pressure. The probable cost of thus raising the head works of both deltas would be Rupees 2,000, and may be included in the estimates for fitting the head sluices with screw gearing.

Damage to head works, slight.

Remedies proposed.

Cost, Rupees 2,000.

Proceedings of the Madras Government, Public Works Department,
29th September 1875.

5. The danger to the head works consisted in the heavy pressure from difference of level above and below the sluices, and the tremendous velocity with which water was passing through some of the sluices. To relieve the pressure, I raised the water in the main canal, Eastern Delta, as high as I could safely, and thereby took in a vast amount of silt which was principally deposited in the main canal, and which will cost Rupees 10,000 at least to remove; the main canal having been widened to nearly full width, while the channels below are still of insufficient width, the deposit of silt was unavoidable. In the Western Delta, where the main canal is not so wide, the silt was carried on and has not caused an unusual deposit. To equalize the rush of water on the rear floor of sluices, I endeavored to raise the shutters of all vents slightly; but, as there is at present no proper lifting gear, the shutters became unmanageable under a head of about 14 feet, and the rush in rear of some of the vents was very great. I do not think any damage has been done to the floors, but until the water is let out of the canals I cannot be certain on this point.

Silt in Main Canal.

Cost of clearing, Rupees 10,000.

6. The leakage through the joints of the masonry of head works was considerable in places, but no stones were displaced; the leakage through the bank between river and canal which extended more or less for 4 miles was more serious, but did not increase in proportion to the head; in fact, after the first day of the high flood, it seemed to me that the leaks were puddling themselves, and I was not apprehensive of the bank giving way. It is, however, I think desirable that a puddle wall should be constructed near the front face of the bank for 1,000 yards below the head sluices.

Puddle wall to face of river banks below head sluices, required.

7. The damage done to Irrigation Works will be described separately for each delta, and the injuries in each delta to channels and to river embankments also separately referred to. The cause of all the damage was the bursting of the river embankments, and the effect was felt principally in the upper portions of the delta near the points where the river embankments first breached.

Specific cause of damage to works.

These points were a little above Walloor in the Eastern Delta, and nearly opposite in the Western Delta; the country here being nearly 30 feet above H. W. mark, the surface of the water had an immense fall, and the flood swept over great portions of the delta; below this the head of water being less, the breaches were less extensive until near the sea in the Divi Island where the water was nearly level, and the banks were probably injured more by the wash than anything else.

Breaching of river embankments at and opposite Walloor.

8. Above the anicut the river is embanked only on the east side from Bezorah to the Condapalli hills near Ebrampatam, a distance of 9 miles; this embankment was not breached fortunately, and its preservation is due to the exertions made by the villagers, who were washed out from their houses inside the bank and were encamped outside; all that I could do was to send up Overseers and Maistries, leaving to the villagers to find the labor, which they did, as, had the bank given away, they would have been in a very dangerous position. The water rose to the top of the bank, and was kept in by placing sods on the low parts; had the bank given way, the Ellore canal must have been breached and a great part of the country towards the Colair flooded.

River embankment on east side above head works.

In danger, but not breached.

On the west side of the river there is no embankment, and here the water spread to within a few miles of Guntoor swamping several villages. To protect these villages in very high floods it would be necessary to raise an embankment for probably about 20 miles, but I am not certain that the work would be appreciated even by the villagers who suffered this time, as any moderate flood would do them no harm and manure their lands which are cultivated exclusively with dry crops.

No embankment on west side above head works.

May be necessary.

9. EASTERN DELTA.—The Irrigation Works in the Eastern Delta that have suffered most are the Masulipatam canal and West Side channel. The water after bursting the river embankment near Walloor, topped the west bank of canal from a short distance below Kankipad to below Walloor, and cut some very deep breaches through both banks; the east bank of the canal also breached about 2 miles above Veeranky lock. The water that passed through these breaches flooded the country up to the Pullairoo, filled and breached the Capalaishwapuram tank, and filled up the large hollow on the east of the canal near Inampudi; it then burst through the canal at Inampudi, Ooratoor, and Pamarru on its way back towards the river, and submerged the lower part of the Sallapalli Zemindari. Some of these breaches were 30 feet deep below water surface after the flood subsided, and extended through both the canal and the West Side channel. Lower down the canal the water again breached into canal and out again, and also passed over the Sultanagarum aqueduct side walls, but the damage done below was trifling, the level of the water inside and outside the canal being much the same. It is estimated that the repairs to these works will cost Rupees 20,000. Several of the tanks in Divi also breached, but here also the water had spread over the whole country, and the necessary repairs will cost very little; breaches also in the minor channels into which the water found its way are but trifling.

Damage to works.

Masulipatam and West Side canal.

Cost of repairs, Rupees 20,000.

10. WESTERN DELTA.—In the Western Delta the bank channel, the Nizampatam canal, and the Iskapally channel suffered severely, the heaviest breaches being those first made in the bank channel at Moonanghy nearly opposite Walloor. In the first 20 miles of this channel there were thirty breaches, some of them of great width and depth. Below this, though the breaches were numerous, they were not so serious. The river water backed up the bank channel, opened the lock gates at Ravandrapad, and flowed down the Nizampatam canal, but there damage was prevented by opening both escapes into the Commamore channel and the Jagerlamoody escape into the Tungabhudra. At Moonanghy, the river bank being carried away, the water set directly into the main drainage and flooded the country up to the Nizampatam canal, then breached through the canal in many places between Intoor and Nizampatam and formed its way into the Tungabhudra. The breaches were all ring bunded with turf as quickly as possible, and many must remain so until the canals are dry, as no earth is procurable. Accurate estimates have not therefore been yet made, but the repair of first 9 miles of bank channel has been estimated at Rupees 13,450, and the total repairs will probably cost Rupees 30,000.

Nature of damage.

Accurate estimates of cost of repairs not made.

Probably Rupees 30,000.

11. The river embankment, Eastern Delta, breached in several places after having been topped in low parts by the water, and in other places it seems to be beyond doubt that it was purposely cut by the villagers who were living on the river lunkas, and who thought that by allowing the water to spread the depth about their villages would decrease. The principal breaches are at Walloorpolem where the water first entered the Delta near Kottapollem, Iyodia, and Nadacudurn. The embankment round the island of Divi, which has lately been raised, suffered from the wash also greatly, the slopes being cut away in places. It is estimated that it will cost Rupees 20,000 to put the river bank

River embankment.

Eastern Delta.

Several breaches.

Cut by villagers living within them.

Entirely in Zemindari, as there is no bank canal.

Divi Island embankment damaged.

...te of repairs to river bank, Rupees 20,000.

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29th September 1875.

12. The river embankment, Western Delta, breached in some places about Vallabhapuram, where the bank canal joins it, and from this point the description of bank canal applies to it over and above what it will cost to close the breaches for the purpose of re-opening the canal to full supply, the cost of making up the river bank will probably amount to Rupees 10,000.

River embankment.

Western Delta.

Several breaches.

Cost of repairs, Rupees 10,000.

13. To repair the damage done to channels in both Deltas will, therefore, cost Rupees 50,000, and to restore the river embankment Rupees 30,000, besides which clearing the silt brought in will cost about Rupees 10,000.

Repairs to channels of both deltas—

	Rs.
Will cost	50,000
River banks	30,000
Silt	10,000
	90,000

14. To prevent damage for the future the river embankments should, I think, be raised 2 feet above the height to which they are to be brought, according to the completion estimates now being submitted; the bank above the anicut from Bezorah to Ebrampatam should also be raised 3 feet, and the embankments round the island of Divi; these last should be carefully maintained, as if the river water is confined within banks above Divi, the surface in a heavy flood will be so high that, in case a breach occurred, the top of the river embankment would be the only dry land in the whole island. The cost of making up the embankments may be estimated at Rupees 1,00,000.

Measures to prevent future damage.

River embankments raised 2 feet above level taken in completion estimates.

Bank above Bezwada raised 3 feet, also bank round Divi.

Cost of making up river embankments, Rupees 1,00,000.

15. The earth required for making up the embankments will be chiefly provided from the excavation and widening of the bank channels, the estimates for which will, it is hoped, soon be sanctioned; the river embankment can be more carefully maintained as the canal bank than when separate, and when the canal in the Eastern Delta is commenced, the bank will be taken over from the Zemindars who have hitherto claimed it.

Earth for raising banks of river provided for bank canal.

16. The most dangerous places on the embankments are at or near villages where the bank gets worn down by people and cattle crossing, and these are worst where the villages are situated within the river embankment, the villagers not being interested in keeping up the bank, and, as mentioned above in some cases, actually cutting the bank with the object of reducing the flood. The Revenue authorities are endeavoring to persuade the villagers inside the bank to move to the outside by giving land for buildings, and I hope that in time all villages will be protected by the bank, and the people will thus be interested in preventing breaches.

Dangerous places in embankments are near villages.

Emigration from within to outside of embankments prevented by Revenue authorities.

APPENDIX C.

Descriptive Account of the great flood in the Pennair in October 1874, *and the damages caused by it within the limits of the Nellore District.*

THE Pennair enters the district at the Somaishweram gorge, which is 68 miles from the sea, and traverses a well-defined valley until the western extremity of the northern delta is reached at Sangam, a village 32 miles east of the Somaishweram gorge. From this village the configuration of the country on the left bank of the Pennair is decidedly deltaic, and, therefore, subject to severe inundations during high floods in that river. This remark does not, however, apply to the right bank of the Pennair for several miles east of Sangam, as the country in those parts, as far as Baburow's Chuttrum, like that on both banks of the Pennair west of Sangam, rises

Valley of Pennair noticed.

from the river and prevents the spill from the latter spreading, even in extreme floods, beyond a narrow margin.

2. From what has been stated it will be observed that in high freshes the country on the left bank of the Pennair between the Somaishweram gorge and Sangam could not be flooded to an alarming extent, and that the spill from the right bank of the river between Somaishweram and Baburow's Chuttrum would soon be arrested by the adjacent high land.

3. Having thus briefly noticed the outline of the country adjoining the Pennair, I will now refer to the recent flood and the disastrous results that attended it.

Rise and fall of the flood at the Nellore Anicut.

4. The Pennair commenced to rise rapidly at 5 o'clock A.M. on Sunday the 25th of October last, and at noon had risen to 15 feet 5 inches on the crest of the Nellore anicut, or to within one inch of the level of the great flood of 1852. The river continued to rise gradually during the remainder of the day, and at 6 o'clock that evening the depth of water on the crest of the anicut was 16 feet 9 inches, or 1 foot 3 inches above the level of the greatest known flood. The flood attained its maximum height (18 feet 4½ inches on the crest of the anicut, or 27 feet 4½ inches above the deep bed of the Pennair) at 8 o'clock on the morning of the 26th October, and remained at that level until 6 o'clock P.M., when it began to subside. On the morning of the 27th, the water had fallen 1 foot 4½ inches, in the evening it was 1 foot 2 inches lower, and at 6 o'clock A.M. on the 28th it had decreased to 22 feet 10 inches, or to 4 feet 6½ inches below the maximum height registered.

5. The annexed extract shows the depth of the water on the crest of the anicut* from 6 o'clock P.M. of the 28th of October to the end of that month when all danger was over, and measures were in progress to repair the damages done during the inundation:—

* The crest of the anicut is 9 feet above the deep bed of the Pennair.

Time.	ft.	in.
October 28th, 6 P.M.	11	0
„ 29th, 6 A.M.	9	0
„ 29th, 6 P.M.	7	10
„ 30th, 6 A.M.	6	8
„ 30th, 6 P.M.	6	0
„ 31st, 6 A.M.	5	0
„ 31st, 6 P.M.	4	6

Effects of the flood on the Nellore Anicut.

6. The principal work injured by this unparalled flood was the anicut across the Pennair in the vicinity of the town of Nellore. The northern flank of that work was turned on Monday the 26th of October, very soon after the flood attained its maximum height, and a deep channel was soon cut by the stream between the wing walls of the anicut and the land on the north of the river. The foundations of the wings were undermined by the scour through this channel, and they appear to have collapsed about noon on the 26th of October. The body wall of the anicut adjoining the northern front wing was also undermined and destroyed for a length of 80 feet.

7. There had evidently been a considerable scour in front of the anicut for some distance south of the northern under sluices, as the groynes there were partly dismantled, and the soundings taken immediately after the flood showed that the bed of the river close to the anicut at the site indicated had been lowered 15 or 16 feet during the freshes of September and October.

8. The result of this scour so close to the anicut was a minute longitudinal crack along the crest of that work for about one half of the length of the pool in front of it. This crack is not, however, of any practical importance, and I do not anticipate any change in it for the worse, as the depression that caused it has been filled in, and measures will be taken to prevent a similar scour there or near it before the next monsoon.

9. In one part the rear slope of the anicut from the first retaining wall for an average length of 146 feet was destroyed, and the displaced stones were carried some distance beyond the last retaining wall by the flood and piled up in a huge heap in the bed of the Pennair.

Several of these stones weigh about 2 tons each. Three of the four retaining walls in this portion were destroyed, and the fourth was so much shaken that it had to be taken down and rebuilt.

10. The rear slope of the anicut suffered a little at its junction with the walls of the northern and southern under sluices, but the cost of repairing those damages will not amount to much.

11. The loose rubble apron of the anicut subsided about 1½ feet throughout during the freshes of September and October, and it is likely that additional stone will be required to strengthen it in parts.

Breaches in river embankment west of anicut.

12. The river embankment between Narsimulcondah and the anicut head works breached at the following places and allowed a considerable volume of water to find its way into the town of Nellore and into the Southern Delta:—

Rangavoikulupetta at the Nellore Civil Dispensary close to the village of Pottepolem.

Effects of the flood in the town of Nellore.

13. From these breaches the water entered the town and flooded a considerable portion of it. Fortunately no lives were lost by this catastrophe, but a number of houses and huts collapsed; some of the principal streets and several of the minor thoroughfares were until the inundation subsided converted into water-courses running from 1½ to 4 feet in depth, and two of the bridges within Municipal limits were much injured by the great scour they were exposed to for four consecutive days.

Damage done in portion of Southern Delta under anicut.

14. After sweeping through the town, the water was arrested by the western spoil bank of the Sarvapully channel, but this obstruction was soon overtopped and breached in many places. The channel now became a deep and rapid river that seemed likely to considerably injure, if not destroy, most of the masonry regulating works, but happily they escaped with little or no damage. The reverse was, however, the case with the channels and embankments; they were much cut up and injured by the water from the town and by the water that found its way in through the sand hills at three points between the anicut and the sea; but, on the whole, the Southern Delta Works, with the exception of a few tanks, stood the severe trial they were subjected to in a most satisfactory manner.

Nellore Tank breaches.

15. The flood bank between the high land at Narsimulcondah (the head of the Southern Delta) and the Nellore tank head sluice breached on the morning of the 26th October. From that moment there was direct communication between the flood water of the Pennair and the Nellore tank. The latter, of course, began to rise rapidly, but it did not burst until a short time before day-break on the 27th, and then it gave way in two places. One of these breaches was costly to close, but no particular damage was done by either, as the great bulk of the water flowed at once back into the river, west of the town of Nellore.

Effects of flood in Northern Delta.

16. At Sangam, the head of the Northern Delta, the flood turned one flank of the Gandavaram head sluice and destroyed the northern front and rear wings of that structure. The adjoining vent also suffered by the sinking of the wings and will have to be rebuilt.

17. The Pennair also breached into the Duvuru tank supply channel close to the Duvuru head sluice, but fortunately without injuring that regulator in any way.

18. Between Sangam and the sea the flood submerged about 153 square miles of the Northern Delta and did considerable damage. A deal of private property was lost or destroyed, valuable crops were under water for several days, thirty tanks breached, the Cuddapah road was very much cut up and injured, and the Great Northern road for a length of 6 miles from the Nellore anicut was badly breached throughout. On this section of the Great Northern road, the bridge of two arches over the Nulla Calwah was partially destroyed, and the rest-house on the north bank of the Pennair was swept away.

19. On the Cuddapah road east of Sangam, one masonry culvert was destroyed, and one wing of the Vagoor channel bridge collapsed from the effects of the flood.

20. West of Sangam, on the left bank of the Pennair, the flood swept across the 22nd, 23rd, 24th and 25th miles of the Cuddapah road. The stock of road metal on the 22nd and 23rd miles was carried away, and within the limits of the 24th and 25th miles the road breached in several places.

Effects of the flood west of the Delta.

21. On the right bank of the Pennair a few tanks and river channels breached between the Somaishweram gorge and the head of the Southern Delta at Narsimaleonlah. In this section the 46th, 47th and 48th miles of the road from Nellore to the Somaishweram gorge were partly washed away, and a deal of land on the margin of the Pennair was lost by erosion and amalgamated with that river.

22. From the accompanying statements it will be observed that Rupees 3,09,910* will probably be required to repair the damages done, and that a further expenditure of Rupees 2,89,000 will be necessary to preserve the valley of the Pennair from inundation during a similar or somewhat greater flood than that of October last. The proposed outlay is no doubt considerable, but it is small in comparison with the public and private interests at stake and the general welfare of the people in the Northern and Southern Deltas of the Pennair.

* The cost of lengthening the Nellore anicut is included in this item.

NELLORE,
26th March 1875.

(Signed) R. SMITH,
District Engineer, Nellore.

APPENDIX D.

From Captain J. PENNYCUICK, R.E., District Engineer, North Arcot, to Lieutenant-Colonel J. MULLINS, R.E., Chief Engineer for Irrigation, dated Vellore, 23th January 1875, No. 3,028.

IN accordance with your memorandum, No. 1,033, of 12th ultimo, I have the honor to report as follows regarding the damage done by the floods of October last, and the probable cost of repairing the works injured, so far as can be at present ascertained:—

2. Of individual Irrigation Works damaged the most important are—

1. The anicut across the Palar near Arcot.
2. Do. do. the Poiney river.
3. Do. do. the Cheyaur.
4. The Poondy large tank near Wallajahpett.
5. The Poorsay tank on the road from Wandewash to Trivatore.

3. This anicut was 2,600 feet in length, and of this nearly half or 1,200 feet have been washed away. The anicut gave way first near the middle of its length, apparently owing to the destruction of a portion of the first apron, leaving the rear of the body wall without support. Through the breach thus caused an extraordinary lateral scour took place, and the front of the body wall was undermined, the wall itself having fallen upstream except for a short length near the middle of the breach. The flood rose to a level 9 inches above the previously recorded maximum (that of May 1872), and would doubtless have risen higher still but for the anicuts having given way. The cost of repairing this work cannot be accurately estimated as yet, as it will depend to a great extent on the quantity of material, especially cut stone, which may be recovered. It is believed that Rupees 1,20,000 is as near an approximation as can be made at present. The revenue under this anicut is stated by the Collector to be Rupees 1,55,643.

The Palar anicut.

4. The destruction here has been more complete even than in the case of the Palar anicut, the anicut having been completely carried away from end to end, nothing being left but the under sluices on each flank. It is difficult to understand why this anicut should have given way

as the water did not rise to within a foot of the level of the flood of May 1872. It is certain that there was nothing wrong with the apron, and I have sought in vain for any satisfactory explanation of the damage.

As nearly as can be judged at present, the cost of restoration will be about Rupees 60,000; the revenue under the anicut is Rupees 72,000.

5. The damage in this case has been comparatively slight, the road embankment leading up to the anicut having given way before the floods attained their full height, which, however, was 3 feet above the previously recorded maximum. The channel has been damaged in several places; the cost of repair is estimated at about Rupees 6,0.0.

The Cheyaur anicut.

6. This tank breached by the overflow of the Palar, bringing an entirely abnormal quantity of water into it; it was in good order, and its escapes are ample under ordinary conditions. The water from the tank breached two smaller tanks lower down, as well as the Cauveripauk and Mahindravady anicut channels. The tank has already been repaired and is now almost full, and measures will be taken to prevent a repetition of any disaster of this kind by a proper embankment to the river above the anicut. It may be mentioned here that this is only one out of numerous instances of damage to both public and private property from the overflow of the Palar and Cheyaur rivers, and that the proper embankment of these rivers is a matter of the highest importance. The estimate for the repair of the Poondy tank itself is Rupees 3,150, and the repair of the damage done to the works below it will cost about Rupees 7,000.

The Poondy tank.

7. This tank the largest in the Wandewash taluq is the terminal tank of the Cheyaur main channel. It was not actually breached, owing to the road from Trivatore to Wandewash running along the bund which was therefore of unusual width and metalled on the top. The bund was, however, topped nearly from end to end, and reduced to a perilously small thickness in many places. The cost of repair is estimated by the Range Officer at Rupees 7,000, but no detailed estimate has yet been made.

The Poorsay tank.

8. Of minor works, the total number injured is about 120, the largest number being, as usual, in the Wandewash taluq, where sixty tanks have been more or less injured; these works are, however, of but small importance, and in most cases the injuries are not very great. It is believed that Rupees 25,000 will cover the cost of repairs to these works.

9. The total extent of damage done to Irrigation Works may be summed up as follows:—

	Rs.
Palar anicut	1,20,000
Poiney do.	60,000
Cheyaur do.	6,0.0
Poondy tank	11,000
Poorsay do.	7,000
Minor works	25,000
Total ...	2,09,000

10. It is not quite clear whether this report is intended to include works other than those of irrigation, but it will probably be expedient that it should do so. The communications have suffered very severely in almost all parts of the district, excepting the Vellore and Arcot taluqs, the most important work injured being the bridge over the Palar near Vellore.

11. This bridge originally consisted of forty-two arches of 43½ feet span, of which sixteen have fallen, and two more are so injured that they will have to come down. In addition to the reconstruction of the fallen arches, it will be necessary to construct protective works similar to those under construction for the Railway bridges in the district, as the foundations of the bridge piers are so manifestly insufficient that without some additional protection the disaster is sure to recur. As yet it has not been found practicable to make a complete estimate of the cost of restoring the bridge, but I believe that Rupees 125,000 will be very near the truth.

12. The bridge over the Goriattum river on the road from Palmanair to Bangalore has been damaged in a very remarkable manner, the flood having risen to a height of 1¼ feet above the roadway, and completely carried away everything on one half of the bridge, except the bare arches and piers, besides forming a breach at 150 feet in length in the approach embankment. I have since visited the site, and it certainly appears almost incredible that the bridge should have stood, as it has done, without a crack in any arch or pier. The cost of repair is estimated at Rupees 2,400.

13. With the exception of the two works abovementioned, the roads which have suffered most have been those near the Cheyaur in the Wandewash taluq and those between Arcot, Ranipett and the Palar anicuts; these have all been greatly injured by the overflow of the Palar and Cheyaur rivers. Estimates have already been received for nearly all the repairs necessary to roads, great promptitude having been shown (especially in the Wallajah and Polur Ranges) in the preparation and submission of estimates.

14. Making allowance for a few estimates still to be received, it is believed that the total cost of repairing damages to communications will be nearly as follows:—

	Rs.
Palar bridge	125,000
Minor works in Wallajah Range	6,000
Chittoor Range	5,000
Vellore do.	1,000
Polur do.	9,000
Total ...	1,46,000

15. In addition to the public works of the district, the Irrigation Works of the great Zemindaries which occupy more than half its area are known to have suffered severely. I have asked the Collector to communicate to me any information he may receive from the different Zemindars, but at present we know very little about works of this class. It is known, however, that the utterly unprecedented flood in the Goriattum river, which injured the road and Railway bridges, was caused in great measure by the breaching of tanks in the Poonganoor Zemindari.

APPENDIX E.

From J. W. RUNDALL, Esq., District Engineer, Tinnevelly, to Lieutenant-Colonel J. MULLINS, R.E., Chief Engineer for Irrigation, dated Nallamali, 6th March 1875, No. 187.

I HAVE the honor, as desired in your memorandum, No. 1,033, of the 11th December 1874, to report further on the floods of November last in this district, especially with regard to the measures necessary to prevent recurrence, under similar circumstances, of the damage to works which then occurred.

2. My letter No. 135 of the 9th December 1874 contains a history of the damage done, and I have nothing to add to this, except to note here, 1*st*, the failure of the Yeral Syphon sluice reported as cracked only in this letter; 2*nd*, that the number of small tanks in the Nanguneri and eastern portion of the Tenkari taluqs which were breached was considerably more than I had originally understood had suffered. Also the cost of repairing injured works, especially as regards the river bund, was in this letter underestimated by me.

3. I will therefore now state *seriatim* the measures necessary to prevent future accidents, referring to each work in the same order as mentioned in my previous letter.

4. CANNADIAN CHANNEL.—The damage to this channel was comparatively small. The head sluice will be completed in two months, and then the chance of flood damage will be lessened. One considerable stream, the Koriar, passes through this channel just below the large town of Calladakurichi. The present escape (called Anjamathagu) consists of a long weir furnished with six vents, with floors at channel bed level. The length of the weir crest (which

Paragraph 6.

is unprovided with dam stones) is 283 feet, part of it is above full supply level. The vents are not of equal size, but aggregate 64½ feet in length. Two of the vents only which are of modern construction are provided with shutters; the others are closed with boughs and turf. All are stated to have been opened the day the heavy rain commenced. Repairs are required to the old vents, the eastern wing requires raising, and a wing wall should be built at the western end. As after every flood there is a considerable deposit of sand in the channel just below this weir, it would be advisable to put two powerful sluices a little further down the channel where there is a suitable site. The Cannadian channel below the Anjamathagu receives the drainage of about 30 square miles which enters at various points, but the surplusing works are generally sufficient.

5. KODAGAN CHANNEL.—The flood at the Aryanaigapuram anicut was 3·35 feet higher than from information derived from the Channel Monigars we had assumed the maximum flood to be when sending in the design for the head sluice. An extra flood bank on the left of the channel is therefore necessary, and will be included in a revised estimate for the head sluice. The right bank of the channel also requires raising for some distance below the head sluice. The first old surplusing work in this channel is topped during high floods, and should be built up to river flood level. The next escape is at Milakallur; this is supposed to pass the water from the Odei on which the new tank sanctioned in G. O., No. 3,194, dated 11th November 1874, is to be formed; but, as breaches are of constant occurrence, it is evident that the escape has not at present sufficient surplusing power. It now consists of three vents each 5 feet by 5 feet; four extra vents can be added each 5 feet by 5 feet, and, as the available head will be about 2½ feet, this will probably suffice.

Paragraph 7.

6. The next escape is at 6 $\frac{5}{8}$ miles, and discharges into the river below the Pahlavur anicut. This is a long wall on different levels; it should be improved by cutting down the higher parts to full supply level and raising the lower portions to the same.

7. Beyond this work any surplus from the Kodagan channel has to pass through the Tinnevelly channel also.

8. The Kariselkulam surplus enters the channel immediately to the north of Pettah at 12½ miles. The proposed arrangements for dealing with this drainage will hereafter be described.

9. The Kodagan channel from its 11th mile up to the Chutrum Puthukulam tank into which it finally enters has a rocky bed with a very small fall. The bed fall cannot be altered, but the banks require raising to 9 feet above bed level.

10. PAULIEM CHANNEL.—Here also the information as to previous flood level was inaccurate, and the flood bank will have to be carried up much further than was provided in the original estimate, as well as raised much higher. The river when in flood tops the first surplusing work on this channel, which must therefore be built up or removed. The next two escapes require but little alteration, as not much drainage enters the channel till the Pachiar is reached.

Paragraphs 8 and 9.

11. The Pachiar drains about 110 square miles. Allowing, as directed in paragraph 8 of your inspection notes, for 2 feet going over the escape and for fifteen under sluices 6 feet by 4 feet, the length of weir crest required to discharge the probable flood would be 1,032 feet. It will be difficult to arrange for this length. I would, therefore, suggest 2½ feet over the escape being allowed, when 740 length of weir crest will suffice. Detailed plans and estimates will be prepared and submitted for your approval.

(110) 1 × 563·5 = 12,932 cubic feet per second.

12. Below the Pachiar, the breaches in this channel were inconsiderable, and with the Pachiar floods disposed of and Tambrapurni floods excluded the existing escapes will doubtless be found sufficient.

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13. TINNEVELLY CHANNEL.—The river rose to within 1 foot of the top of the bank in several places in the first 3 miles of this channel, and raising is therefore required. The crest of the first escape is below river flood level; this work can be removed after the construction of the proposed head sluice. The second escape weir requires partial reconstruction and alteration. The third surplusing work (Sherthangimathugu) requires an extra vent and alteration of crest. The surplus from the Suttamallay tank (supplied by Kodagan channel) enters a little above this work and causes frequent breaches. This escape is built on rock and the extra vent can easily be put in.

Paragraph 10.

14. The other extra surplusing works required on this channel are in connection with the diversion of the Kariseckulam Odei floods. An Overseer is now engaged in taking levels for this scheme and, as soon as possible, the details will be worked out and submitted for orders. Until the levels have been completed, I am unable to state what would be the most feasible and economical arrangement. Under any circumstances, the scheme will be costly, and it will involve the construction of bridges over Roads Nos. VII., VIII., and XXIII., and the reconstruction of the Chutrum Puthukulam calingulah.

15. MARDUR MELAKAL.—The surplus escapes on this channel can remain as they are. The Thutagudi calingulah is sufficient to pass the discharge off the 30 square miles which drain into the channel at this point, when once the Ponnagudi series of tanks have been put into proper order and provided with efficient escapes. If the present Nirnniken establishment employed under the Revenue Department were efficient, extra hands would not be required to work the vents in this calingulah (paragraph 4 of your note printed with G. O. of the 29th January 1875). The question of establishments for the channels is one on which I propose to address you separately.

Paragraph 13.

16. Another considerable Odei draining also about 30 square miles enters this channel just above the Vellore tank. This and the Tenkarei tank are almost one, being separated only by a low calingulah, and it is very desirable that as much as possible of the flood water entering the channel should be passed on into the river at the present western calingulah of the Vellore tank, and prevented from passing on into the Tenkarei tank, from which the only line for surplus is through the Kadamba tank, and on through the low lying but valuable irrigation under the latter tank. The Tenkarei tank surplus enters the Kadamba tank south of the Kadamba head sluice, and does not pass over the calingulah alongside of that work, as stated in paragraph 20 of your inspection notes. The Nunjei surplus alone passes over this calingulah.

17. The Vellore western calingulah has at present 170 feet effective length, and this work should be lengthened to 315 feet, with a flush crest at full tank level. There is a second (effective length about 30 feet) calingulah (besides that dividing the Vellore and Tenkarei tanks) which requires considerable repair. The water from this passes into the Streevigundam south channel. As the calingulah exists, it may be well to restore it with crest at 6 inches above full supply. It would then pass water only during excessive floods. An additional area of 20 square miles drains direct into the Tenkarei tank. Flood water from this must pass on into the Kadamba, but if the larger volumes entering above the Vellore tank are passed on into the river direct, the smaller quantity from this area may be passed through the Kadamba and its surplus channel without danger. The banks of the Vellore tank require to be raised to allow 3 feet to pass over its western calingulah with safety. Levels have been taken, and estimates for this are under preparation.

18. The bridges over the Thutagudi and Adichanallur (Vellore western) escape channels on Road No. IV. will require reconstruction or considerable additional waterway. The Thutagudi escape channel will have to be embanked on both sides and connected with the river embankment. The whole of this embankment from Puthugudi westwards will require to be raised considerably. Levels for this have been taken, and estimates are under preparation.

19. MARDUR KILAKAL.—The river banks will probably have to be carried up from Streevigundam to the west of Sivalaperi. The levels for these banks have been taken and the details are being worked out.

Paragraphs 20 to 24.

20. The drainage entering the Mardur Kilakal near its head comes principally from the Kaliavur tank into which about 8 square miles drain. The calingulah of this tank requires lengthening.

21. The Manalvari or sand sluice in the Kilakal at 2¼ miles from the head requires to have its wings rebuilt and raised.

22. I find that it will not be practicable to make use of the ruined calingulah (referred to in paragraph 22 of my letter) as a surplusing work. The river floods at this point rise to 6 feet or 7 feet above channel full supply level. The land drainage must therefore be carried on down the channel to the next escape at 4 $\frac{7}{8}$ miles. This work will have to be considerably increased in size and the details will be worked out. The next escape at Manakarei probably requires to be increased, as a considerable amount of land drainage enters the channel immediately above it from off the range of hills east of Valanad.

23. When the river floods are excluded from the channel by a sufficient embankment we of the head sluice, the channel can carry 300,000 cubic yards per hour of land drainage up to th escape at 4 $\frac{7}{8}$ miles, as the right bank is both high and strong. It was the river flood from abo the head sluice which was the principal cause of the breaches.

24. The Streevigundam Periakulam has an ample calingulah, as also have the Perur a Shevelly tanks. The Perungulam (last of the series) is provided with sluices capable of dischar ing about 100,000 cubic yards per hour (750 cubic feet per second) at full tank level, but it desirable, I think, to provide for extra surplusing power here, as there was a breach (though small one) in the tank in 1869, which, however, might have been more serious, had not the Stree gundam Periakulam and Perur tanks breached in many places. It would be advisable to add escape weir 100 feet long at 1 foot below full tank level. In this case the banks of the surp channel will require raising for about 1½ miles above the point where the surplus joins Streevigundam north channel.

25. The bridge and calingulah will require altering and should have five instead of th vents of 4 feet. This and the Aramugamungalum double dam 2¾ miles further on will be able discharge at least 1,600 cubic feet per second, and the Aramugamungalum tank calingulah o 300 feet in length can discharge this quantity without endangering the tank. The surplus t passes through an old channel of considerable size into a salt creek south of Palayakayal villa

26. STREEVIGUNDAM NORTH CHANNEL.—The reconstruction of the syphon sluices at Y and the alteration of the bridge and calingulah are the only works required in this chan Your orders to give the former a waterwa 165 square feet will be carried out. The br and calingulah alterations have been referred to above; the masonry apron and water wings this work will, as directed in paragraph 38 of your inspection notes, be estimated for.

Memorandum, No. 191, of the 15th February 1875.

27. STREEVIGUNDAM SOUTH CHANNEL.—The floods did not show that any extra works required in this channel and its tanks. The improvement of the Kadamba bank and calingu as directed in paragraph 20 of your inspection notes, will receive attention.

28. On the north side of the river the embankment will have to be commenced from west of Sivalaperi village and carried continuously to the Mardur Kilakal. From this to Mankari the Kilakal bank should, if possible, be utilized as the river The objections to this are, first, that a few villages would be to some extent swamped, bu they always have been; secondly, that about ½ mile of the Tuticorin road will be swamp every high flood. I am just going over the ground, and, as levels for a bank along the

River Banks.

margin have been taken, shall be able to settle the matter next week, and will report further. From Manakari to Streevigundam there is an existing bank which requires improvement.

29. Below Streevigundam both banks will require raising. The embankments, as carried out in 1872-73, were made 3½ feet above the supposed flood level of 1860. An uniform slope (24 feet per mile) from Streevigundam to the east of Aáttúr being assumed. These banks were nearly 3 feet above the last flood both at Streevigundam and Aáttúr village; but still raising will be necessary, for the volume of water which passed through the breaches above Streevigundam and at Alwár, Tinnevelly, Tentiraperi and Saythukuvóithan would, had the breaches not occurred, have raised the flood level very considerably at and below Aáttúr and to a less extent at other places to the west.

30. I think, therefore, the bank should be made 4½ feet and 6 feet, respectively, above 1874 flood level at Streevigundam and Aáttúr; also 4½ feet to the west of Streevigundam. Observations as to the height of the flood in various places have been recorded, and from these the bund level can be determined. Your instructions on this point are solicited.

31. It will be impossible to put a wall or core of clay in the bund as suggested by you, for clay cannot be obtained. The best precaution seems to be that all additional earth for widening should be put on the inside of the bund.

32. The Collector has already commenced the removal of padagay plantations. Unless, however, as much care is taken to effect removal of the trees as was originally bestowed on their growth, the removal is not likely to be as quickly carried out as it should be. The Revenue Officers, having originally had the planting of these trees, seem backward to destroy their own work, but the entire removal of all thorn trees should, I think, be insisted on.

33. There are many trees in the bed proper of the river, and their growth was encouraged by Mr. Puckle.

34. The Collector has also stopped the indiscriminate conservation of nanel. Considerable sums will, however, have to be spent annually in removing and rooting up growing nanel from the river bed in various places. Rupees 3,000 per year for the next five years will probably be required for this service between Sivalapéri and Aáttúr.

35. I have had statements prepared showing approximately the cost of carrying out the various works above enumerated, and also for effecting improvements to the various breached channels and tanks not mentioned in detail. The following shows the approximate amount taluq by taluq :—

	Rs.
Streevelliputtur	5,000
Sankaranainarcovil, no flood damage.	
Sattúr ... ... do.	
Tinnevelly	51,000
Tenkarei	1,14,100
Ottapedarum, no flood damage.	
Nanguneri	25,800
Ambasamudrum	11,000
Tenkasi	9,000
Total ...	2,25,900

36. Only works damaged in November last are entered, the sum for which is [illegible] have afford any indication of the sum required in this district for Agricultural Repairs and New Works. Many works which escaped damage on this occasion require improvement more than those which happened to be damaged. Of this, however, you are I know aware, so I need say no more on the subject.

Nos. 591 & 592. ORDER THEREON, 29th September 1875, No. 2,780.

IRRIGATION, No. 54.

THE Government have from time to time had information placed before them which has indicated that the rivers and Irrigation Works of this Presidency were in a state ill adapted to stand the strain arising from heavy rainfall. In even good monsoons of a not unusually severe character there has generally been a long list of damages of a more or less important character. After, however, a series of comparatively dry years, 1872 was the first in which a storm in May and very heavy rain on the setting in of the north-east monsoon showed very clearly that of the vast numbers of tanks on which so much of the cultivation in most districts depends, very many were incapable of holding out under such emergencies; while inundations, which to a great extent are preventable, caused widespread destruction of crops and property, both public and private. District Officers, as a rule, had not then recognized, the radical defects of the Irrigation Works generally, the greater number of which are of native construction, and were adapted by their builders only to seasons moderate in character, while for the most part the effect of connected works upon each other, as in the case of groups of tanks, had been altogether ignored by their constructors. The Irrigation Department took measures, however, for the more intelligent treatment of Irrigation Works generally, and though these could not affect materially the character of the work done in 1872-73, their effect has been already felt wherever the instructions obtained prompt attention. Consequently in 1874 the tanks were in far too many cases, notwithstanding large outlay on repairs during the interval, but little better calculated to be safe under severe strain than before.

2. The essential requirements of Irrigation Works and the conditions of safety having now, however, been recognized, and District Officers having been fully instructed as to their proper treatment, it will be expected and required that in every case damage from preventable causes will in the future be guarded against to the utmost extent possible with the means which Government may be able to place at the disposal of the officers concerned.

3. The urgent need of additional funds, especially for Minor New Works, under which head means of disposing of surplus water must be provided, has after full inquiry and consideration been admitted by Government, and the necessary representations have been made to the Government of India, who have in their letter as per margin called for further information on some points, and this is now being collected.

Proceedings, No. 475, dated 17th Feb. 1875.

No. 214 A. I., dated 21st July 1875.

4. The papers now reviewed show that the mere repair of damage sustained by Irrigation Works from the floods of one year in a few districts will cost upwards of 11 lakhs of Rupees, and necessary improvements to remedy apparent defects and remove the probability of a recurrence of similar damage have been estimated to require 14¾ lakhs, while it may very safely be assumed that when the works come to be dealt with individually this latter amount will be considerably exceeded. In the Godavery for instance, a district not affected by the floods of 1874 and not included

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in the list, it is known from more recent reports that the fresh of 1875 was a cause of serious and imminent danger to the delta, and that precautionary measures must be taken at the earliest possible moment to avert such a calamity as any general breaching of the flood banks would undoubtedly be.

5. Formerly but little was known of the state and needs of Irrigation Works, and, in the absence of information, but little could be done to introduce improved management, and unfortunately much of the money spent on mere repairs proved useless. Now that attention has been called to the subject; that the direction and extent in which action is required have been generally ascertained; that at least so far as the means of making investigations necessary to the determination of details provision has been made; and that funds both for repairs and improvements equally essential have to some extent already, and will doubtless to a greater extent ere long be made available, it is absolutely necessary to the credit of all concerned that every year should show a marked reformation in the state of the works, and that all the work that may be carried out should be such as will tend to the ultimate complete security of all works which are so circumstanced as to allow of this object being attained. River conservancy, the regulation of the heads of river channels, the repair of and provision of surplus works for tanks, &c., all need steady and continuous attention, and in each and all of these cases the first thing is to ascertain clearly all causes of danger, and then the most effective and most economical way of removing them.

6. The subject of this order being very intimately connected with the grants under Agricultural, Ordinary, a copy of these Proceedings will be forwarded to the Government of India in continuation of those of the 17th February last, No. 475.

(True Extract.)

(Signed) G. W. WALKER, Major-General, R.E.,
Secretary to Government.

No. 593. (Docket No. 2,781, dated 29th September 1875.
Copy of the above forwarded to the Government of India.

(True Extract.)

(Signed) G. W. WALKER, Major-General, R.E.,
Secretary to Government.

Exd. E. C. Shankar.
Spare Copies

No 1086 A

Memorandum.

Floods of 1874.
Nature & object of Narrative required.

Encl: 35

The Order of Government of the 4th December last No. 3411 A. directed the Chief Engineer for Irrigation to draw up a narrative of the disasters caused by the floods of September and October 1874 showing the nature and extent of the damage done to each work and the conjectured cost of emergent repair as well as of thorough renovation or the provision of such works as would guard against similar disasters in future. Accordingly the District Engineers were called upon to supply the necessary information, and reports more or less in detail having now been received they are reviewed below. It is to be observed

observed that the estimates of the cost of renovation and improvement of existing works as well as that of providing new ones to prevent future disasters depends on the information gained by surveys more or less extensive which take time and which are not yet completed.—

Ganjam

2 The District Engineer Ganjam has supplied a detailed list* of the irrigation works which were damaged by flood*. It shows that the embankments of one river, four channels and thirty eight tanks were breached. Seven masonry works on channels or tanks were destroyed or damaged as well as three bridges. The cost of the emergent repairs will probably not exceed Rupees 1000 and that of renewing

Ganjam detailed list of works damaged
* Appendix

* in October and November 1874.

Cost of repairs Rs 1000

renewing the works or providing new ones where necessary is estimated at Rupees 60,650. It is certain that the latter is merely a rough approximation for there has been no time to consider carefully and one by one the circumstances of each work and to make the necessary calculations on which alone a reliable estimate could be framed.—

Cost of new works Rs 60,650

It is stated that the damage by flood was greater during the year 1873 than in 1874 as the rainfall in the latter extended over a longer period than during the former year and that the damage now brought to notice was chiefly in the southern portion of the District where the freshes were higher than any within recollection.—

3 In reference to the general condi-
=tion of the irrigation work the Distrib- General condition of Irrigation Works in the Ganjam district
Engineer explains that few of the tanks are provided with masonry works of any kind, that river embankments have been much neglected and that the river and hill stream channels which have head sluices are ill pro-
=vided with subsidiary arrangements and are generally in bad condition. There are 3000 Irrigation works on the register (exclusive of those in the Zimindary Estate), many of which however are not worth keeping up. It is proposed as a general measure to provide the more important works with rough escapes of stone masonry cheaply and quickly as far as possible.

4 Such measures based on every case on a clear knowledge of the conditions and the return of revenue for the expenditure to be incurred are doubt-
=less what are required, but the works though numerous are for the most part of insignificant individual importance and their raison d'etre depends on very economical conservancy.

Vizagapatam

Vizagapatam Damages of a petty nature

5 The damage to works in the Vizagapatam district does not ap-
=pear to have been of any great im-
=portance. As in Ganjam those for irrigation are of a petty nature and the estimated cost of repairs only

Repairs to Tanks Rs 7000

amounts to Rs. 7000. The bursting of tanks caused injury to a number of roads and to make this good

2 Road. Rs 6858

Rs. 6858 will be required. The whole outlay on account of floods in this district will apparently not exceed Rupees 14,000.

The District Engineer has hardly touched on the question of the measures required to prevent disasters in future except as regards damage to roads. In reference to this he suggests that all proprietors of tanks should be required to provide Calingulahs or that they should be held responsible for the consequences when they do not do so. Instructions have been issued on this subject to District Engineers who are directed to examine into the circumstances of each private tank, to draw up the necessary instructions for putting them into a secure state and also on the requisition of owners of tanks to prepare surveys plans and estimates for carrying out the necessary works as well as to carry out the same at the cost of the persons concerned.—

Private tanks Responsibility of owners.

6 Allusion is made to the breaching of two irrigation channels for which repair estimates have been prepared.

Kristnaraj and Pulapur.

But

but it is probable that additional works are required for regulating the supply and thus avoiding a recurrence of the damage.—

Kistna

Kistna

Flood of September 1874

7 The effect of the floods in the Kistna on the delta works was disastrous. The report of the District Engineer which describes the damages in detail will be found in the appendix. The river rose on the 26th September 1874 to a height of 19 feet 5" above the crest of the anicut which itself is 20 feet above the bed of the river. This is 11 inches higher than any previously recorded flood.—

×B.

Height of Flood at Anicut.

River Embankments.

8 The Kistna river is confined to its course by embankments which extend on the eastern or left bank from a point some nine miles above the works at the head of the Delta to

to the island of Divi and on the western side from the head works to the sea. Both were breached at points below the Anicut and the flood water spreading over the delta on either side burst into and submerged the canals which traverse it and filled and breached the tanks. There were numerous breaches in the Canal banks and a large quantity of silt was deposited in the main Canal. The repairs immediately necessary will cost it is estimated Rs. 90,000 of which Rs. 30000 will be required for the river embankments, Rs. 50000 for the canals and Rupees 10000 for the removal of silt.—

Breaches in Canal

Repairs Rs 90,000

9. The measures necessary to guard against disaster in the future are to a certain extent indicated by a consideration of the circumstances noted during the continuance of the flood.

Measures necessary for future safety.

The Head works were nearly submerged

Head works

and it is proposed to raise them two feet. The river embankment above the Anicut was in great danger of being overtopped. Those below were so. The Divi island embankment was also injured. It is proposed to raise all these from two to three feet at a cost of a lakh of Rupees.

River embankments Rs 100,000

The villagers living on the land between the river embankment and the river itself, there is much reason to believe cut the bank in several places when the river rose with a view to saving their own tenements by allowing the water to spread and thus lowering its general level. It is proposed to induce these people to move to the outside of the embankments by allowing them free building sites and giving them an interest in the preservation of the protective works

works.—

Nellore

10. It was in the Nellore District Nellore in the valley and delta of the Pennair river that the effects of floods were most severely felt. A detailed account of the damage sustained by the various works of irrigation the roads &c written by the District Engineer will be found appended hereto. The river is confined to its course within narrow limits on the left or northern bank by high land as far as Singum a point 35 miles from the sea below which spreads the Northern delta. On the Southern side this high ground extends several miles lower and prevents flood-water from extending itself to any great extent. It was therefore below these points on the river that the damage to the

General description of river Pennair

Appendix C. X

Maximum height observed

country chiefly occurred.— The river commenced to rise on the 25th October and attained its maximum height of 18'-4½ inches on the crest of the Anicut at 8 O'clock on the morning of the 26th continuing at that level till the evening when it commenced to subside. The level reached was 2 ft. 10½ inches above the highest flood previously recorded but of course the afflux caused by the Anicut must be taken into account.

Nature of damage to Works Southern bank Nellore Anicut

11 The Nellore Anicut which is placed across the Pennair above the town of Nellore was extensively injured. It was turned at its Northern end the wings were carried away and the body of the work adjoining was undermined and destroyed. Scour along the face caused a slight subsidence of another portion and the rear slope was partly torn up and carried down the stream. The loose rubble upon the

subsided

subsided about 1½ feet throughout. The river embankment on the right side above the Amint was breached in three places and the town of Nellore was flooded by the sweeping water, houses and huts were destroyed but no lives were lost. After sweeping through the town the water reached the western spoil bank of the Survapully channel overtopped and carried part of it away and poured down the channel bed which with the banks was much injured. The flood bank between Vaisimilicondale and the Nellore Amint also gave way and this involved the overflow and breaching of the large Nellore tank.

River Embankments

Nellore tank

12 On the North side of the river the results of the flood were similar. At Sungum a portion of the Ganda-ver anicut head sluice was destroyed and the Pennair breached into the Duveru tank supply channel. Between Sungum and the sea 153 square miles

Northern bank

Gandaver Anicut Head sluice

Country sub-merged in Northern Delta tanks breached

Damage to roads

Survapully channel

miles of the Northern Delta were sub-merged much property was destroyed and crops were under water for several days. 30 tanks were breached, the Cuddapah and the great Northern road were cut and otherwise injured for miles and the bridges partly destroyed. One rest-house was entirely swept away.

Above Sungum on either bank the roads to Cuddapah and the Sommasi-sher and gorge were partly washed away and the embankments of a few tanks were breached. A con-siderable quantity of land on the margin of the river was eroded.

Estimated repairs Rs 39910

13 The cost of the repairs im-mediately required as given in detail in the statements which ac-company the District Engineer's report. It amounts to Rs 39910

distribu

distributed as shown below.

Tanks	Rupees	57,400
Embankments	"	9000
Channels	"	32,050
Roads	"	46,500
Anicut	"	16,960.

The charges for the Anicut includes lengthening 450 feet at the Northern end.

14 The works required to secure the delta from inundation are estimated to cost Rupees 287,000. They consist simply in the extension and raising of the existing river embankment on the South side and the construction of a similar work on the North, Rupees 85,000 being allotted for the former and Rupees 198,000 for the latter work - Rupees 2000 are allowed for the planting of Babul grass as a security against erosion. - The embankment on the right bank of the river will be 22½ Miles in length to the sea from

Cost of improvements Rs 287000

from 10 to 8½ feet above the country and 4½ feet above flood level. That on the left bank from Sungum to the sea will be 33 Miles in length, 10 feet above the country and from 4½ to 6 feet above flood level.

Kurnool

15 There appears to have been exceptionally heavy rain in the Kurnool district during the months of July September and October and Tanks and roads sustained considerable injury. Twenty seven of the former were breached and three damaged. The cost of the repairs is estimated at Rs. 22000 for tanks and Rupees 30450 for roads and for preventive measures in regard to tanks Rupees 59,000.-

16

16 The effects of the floods in the Cuddapah district were serious. The rainfall during the months from May to October was largely in excess of the average and in fact exceeded the usual amount for the whole year. The tanks were all full by the end of September and although the slight fall at the commencement of October did no harm the down pour between the 20th and 26th of that month was for the most part at once surplussed over the weir and discharged into the water courses and channel fed tanks were exposed to sudden inrushes of water which in a number of instances sufficed to breach them. The following is a statement of the

Rainfall May to October 1874.

the rain fall (during the period from the 20th to 26th October) which was the immediate cause of the damage.

Date.	Sunnalla = anaikayan	Boddalam	Badvail	Sidhout = Wontimitta	Pullampett.	Cuddapah.	Pollimanda = Dulur	Royachoty	Vontimitta = Pullampett	Gurramkonda = cheruvu	Peddamadur = mallyalla	Kodur = Kodur
	Setti = varipalli	Mundi = alam = patti	Badvail			Cuddapah	Vaim = pally	Gurram = cheruvu	Peddam = mallyalla	Madur = napally	Kodur	
20th	1.15	0.35	"	"	"	0.05	"	"	"	"	"	0.25
21st	"	0.25	0.65	"	"	0.05	"	"	"	1.00	2.85	0.15
22nd	"	2.00	0.15	"	0.40	0.05	0.65	0.11	0.60	0.40	0.20	
23rd	1.90	1.10	2.85	3.50	5.25	2.45	0.65	3.10	3.30	0.90	0.65	
24th	0.60	3.50	1.05	3.80	10.45	3.75	1.60	5.60	5.50	3.20	3.00	
25th	1.40	0.50	3.40	6.60	7.25	5.60	1.70	4.70	5.00	2.25	3.15	
26th	0.10	"	0.15	0.45	0.68	0.40	2.20	0.30	1.70	0.45	1.00	
	5.15	7.70	8.25	14.35	24.03	12.35	6.80	13.81	17.10	10.25	8.40	

Nature & extent of damage.

The rivers fed by drainage, which ran rapidly off the already saturated country, rose to unprecedented heights and overflowed the banks natural or artificial. The Railway which traverses the District was breached

breached in several places and the roads were flooded and injured...

Hydrography of the district

The Pennair river runs through the northern part of the Cuddapah District in a direction from North West to South East and is joined in its course by two considerable rivers, the Cheyair to the South and the Paupignee to the North, these receive the drainage of nearly the whole district. The tributaries of the Cheyair viz: the Gogina, Poolinga, the Panchoo, Bankoo and Rundayur Nadee, were all in high flood and the Cheyair rose accordingly. Its drainage area is about 2200 square miles and the Valley in which it runs opens out about four miles above the point where the Madras Railway crosses it. Here it is embanked and the water broke through on both sides, on the North flooding the country for

The Cheyair river

Embankments breached & Railway damaged

for a mile in breadth and on the South breaching the railway embankment. A mile below the railway bridge the hills close again on the river on the South side and confine it to its course for a short distance but below this as far as Pennagalur a distance of 12 miles from the bridge on the South side and down to Coreumpilly near the junction of the Cheyair and the Pennair on the North the embankments have been almost entirely destroyed the irrigation channels obliterated and the tanks in the margin of the river breached.

Damages in upland tanks.

17 In the upland districts drained by the tributaries of the Cheyair already referred to, the Government tanks as a rule stood the strain on them well. The weirs and their aprons were damaged more or less by the large volume of water pouring over them, but this was no more than might have been expected.

He

The Imunnoor Kitcheena near Rajam-
pett the Chittoor tank about 9 miles
North of Royachoty and the Peddanair
Calva Iyavari Tank were however
breached.. In the first case the failure
which involved the destruction of a
portion of the Railway was owing to the
insufficient length of the surplus weir.
In the second the damage was caused
by the breaching of seven small tanks above
the large one and in the third the bank
gave way apparently on account of its
faulty internal condition. In the ac-
counts furnished mention is made of
various other minor works in this part
of the District which were injured
or destroyed but which it is unnecessary
to notice here in detail.-

Tanks breached

18. The Pauparnee river in its course through the district of about 75 miles receives the drainage of the greater part of Madanapully Talug and

The Pauparnee river

and portions of the Kadiri, Royachoty, Pulivendla and Cuddapah talugs. Five small tanks in the Madanapully talug were breached, and the weirs of thirteen were damaged. In the Kadiri talug a rough stone Anicut across the river and the supply channel from it were injured. In the Cuddapah talug the Pauparnee destroyed great part of the head sluice to the supply channel of the Cumalapoor Tank, filled the channel with sand, breached the tank and carried away a travellers bungalow on the left bank of the river. The Jammalmudgoo talug in the extreme North West of the District is traversed by the Penaar river. Here the Chintaconta tank burst. It had no surplus escape and had never before been in need of one, but on this occasion the supply was in excess of its limit of safe capacity and

Damages on its Course

Cumalapoor Supply Channel

The Penaar river damages Cumalapoor tank.

and the bank gave way. The dis-
-charge washed away the earth work
of the railway more or less for a
length of 4 miles. The Pennair was
in high flood and passing round
the village of Chennoor breached the
trunk road; below Sidhout the country
was flooded but little damage was
done. The injury to works in the
Poddatore and Budvail talugs was of
no great importance.-

17..... The District Engineer sums up the cost of repairing the damage at Rupees 180400 distributed amongst the several talugs as follows- Rs 180400

Pullampett	100000
Veilpaud	4000
Madanapully	8000
Royachoty	20000
Kaderi	6000
Cuddapah	3300
Jammalamudgoo	30000
Poddatore	2800
Budvail	2500
Sidhout	1800
Pulivendlah	2000

Summary of the cost of repairs in the Cuddapah district

But this it is stated only refers to
irrigation works, the injury to local
fund works is estimated at Rupees 30,000
in addition and the amount allotted
to the former does not include the
outlay necessary for raising the Cheyair
embankments and constructing head
sluices so as to render them safe for
the future. Surveys and estimates for
this work are in progress. It is pre-
-sumed that the estimate for the
repairs to the other irrigation works
is based on a consideration of their
requirements and that these again
are calculated on the supposition
that the works are to be made safe
for the future.-

Local fund works
Repairs Rs 30000

Bellary

Bellary
damage 7 lakhs
Rupees

20..... Although the rainfall at
the latter end of October appears
to have been very heavy on the
Bellary

Bellary distrct the damage to the irrigation works was not remarka-bly great. Three of the largest tanks in the District however gave way at their Calingulahs and a number of minor works sustained injury of lesser importance. All the neces-sary repairs could, it was stated, be executed from the current allot-ments.—

Chingleput

21. The district of Chingleput Chingleput was visited with severe floods in 1874 and it had previously suffered from the same cause in 1872. The damage during the former year appears to have occurred chiefly in the month of October. An abstract of the list of injured works furnished by the District Engineer shows the

Floods October 1874

Summary of works injured

The following result.

Tanks breached ——— 259

Supply or river irrigation Channels breached ——— 10

Sluices, Anicuts or Waste Weirs destroyed or damaged ——— 9

River embankments breached or washed away ——— 6.

Cost of repairs Rs 98598

Improvements Rs 298220

The cost of repairs is estimated at Rupees 98598 and that of securing the works against similar damage in future at Rupees 298220.—

The cost of repairs to roads is not included in the above estimate.—

General state of Agricultural works from 5 to the Sea

22 The principal streams draining the District commencing from the North are the Narravaram, the Cortalier, and the Palar. The lesser independent lines of drainage to the sea being the Coum and the Adyar. It is stated by the District Engineer that since the period of the great floods of 1857 the river embankments in the Northern part of the District had been much neglected and tampered with for private purposes by

by the villagers who cut gaps in them for irrigation purposes. The channels leading from the rivers are often unprovided with sluices at their heads to regulate the passage of the water and this circumstance, combined with the spill from the streams when in extra-ordinary flood over or through the embankments led to the overfilling and breaching of tanks, the destruction of waste weirs, and channel banks, and in fact to most of the damage which is reported to have occurred. In other parts of the district the injury to tanks was the result of neglect of the bunds or masonry works and the insufficiency of the provision for the discharge of surplus water. The flood in the Cortelliar resulted in injury to the Anicut at the head of the Channel supplying the Madras Water Works and the embankments of the river and channel were breached. The Anicut on the same river at Kasaveram was turned. The Chingleput Taluq suffered chiefly in the neighbourhood of the Palar. The Madrauticum tanks are said to have been injured by the bursting of those in North Arcot situated on the same drainage lines.—

Cortelliar river

Anicuts damaged

North Arcot

Floods of October 1874

23. North Arcot. The Palar river traverses the Southern part of the North Arcot district. Its principal tributaries in this part of its course are the Goniathinu and the Poiney on the north and the Cheyar on the south. The district was visited with heavy rains at the end of October 1874, and these rivers were in high flood and the damage to various works and to the district was serious. Half of the large anicut across the Palar near Arcot was carried away and the whole of the Poiney Anicut disappeared. The similar work on the Cheyar was injured. The Conda large tank near Wallajahpett was breached by the overflow from the Palar and the Poiney tanks which is supplied by a channel from the latter was lapsed by the water which carried away a considerable portion of the bank without actually breaching it. One hundred and twenty works of minor importance were injured. The above refers to the damage to irrigation works but did not escape. The Palar bridge between Vellore and the railway station gave way for a length of 230 yards. The Goniathinu bridge on the road from Palmaner to Bangalore was swept clear at its upper part. The arches and piers only remaining and the embankment adjoining was breached. The communication in the greater part of the district

Damages Palar Anicut breached, Poiney Anicut disappeared Cheyar Anicut injured

Palar bridge

Communication

serially owing to the overflow of the Palar and Cheyar.

The cost of the repairs to the irrigation works is estimated at Rs. 209,000 and for others Rs 146,000. So far as the Government board is concerned the flood will render necessary an expenditure of Rs 355,000 but this estimate takes no account of the injury and loss in the Zemindaries or private estates which constitute more than half the area of the District. It is stated to have been extensive and that evidence of it is afforded by the unprecedented flood in the Coriattoor river which was caused by the sudden release of water in consequence of the breaching of numbers of private tanks. Appendix C gives further particulars on this subject.

Cost of repairs Rs 209,000 for irrigation works Rs 146,000 for others.

24. South Arcot. The principal objects draining the South Arcot District are the Ponnar or Pedar and the Vellaur. Both are largely utilized for irrigation, on the usual manner by anicuts or weirs feeding artificial channels which irrigate directly or supply tanks and by other channels kept up by the

South Arcot.

The Ponnar & Vellaur rivers

Embankments of Ponnar

Damage by Cyclone of May 1874 & Rains of Septbr & October 1874

existing

cultivator having their heads in the natural bed of the rivers but unprotected by bunds. The Ponnar is also subject to at certain parts of its course, but the embankments as in the case with most of the works of irrigation, were in a state of disrepair. Unusual rainfall occurring and abnormally high flood in the Ponnar resulted naturally in considerable damage to these works which were in its course or connected with it. A cyclone which visited the district in May and heavy rains in September and October produced severally a catalogue of disasters. The Ponnar Anicut was damaged on the first occasion as were also the supply channels leading from it, the head sluice on the north bank completely destroyed. The repairs were interrupted and the damage was extended by freshes in September and October. The Vellaur Anicut on the same river was also damaged by the cyclone the Cuddapah embankment on the Ponnar was in like manner washed away in many breaches, again in September whole villages were submerged and about 1000 houses destroyed again in October the Lodge Anicut was destroyed again and a large portion of the Ponnar Anicut thrown down. Many persons were drowned.

Chandler tanks Cuddapah

25. Of minor irrigation works. The ramified tanks

to about Rs 1500.

27. Generally the north east monsoon burst on this district on the 26th November and produced a flood on the Sambrapurnie the principal river, which caused a extensive damage. The rainfall which caused a extensive damage. The rainfall on the 26th and 27th November varied at different localities from 12 to 6·8 inches. The rise in the river was somewhat less on the whole than in the occasion of the previously recorded inundation of 1869.

Generally

Flood in the Sambrapurnie

The irrigation works deriving their supply of water from the river suffered in the usual manner and from the usual causes. Supply channels taking their heads were unprotected and Sluices to regulate the influx of river water were flooded breached and silted up and the tanks which these channels feeding etc carry water were rendered useless. Inspection of general embankments carried out in connection with distribution also. The provision made for passing the drainage of the country across these channels proved in certain cases to be insufficient and the channel banks were carried away in consequence.

Damage to irrigation works on the course of the river

At the case of Kodur, the channel takes off from the river at a very abrupt bend and the current is directed against the Sambrapurnie embankment which it breached and flooded the adjacent country. The channel banks were also breached in several places and the water escaped to the low land to the north west of the village. The breaches were repaired and the channel brought to clear as soon as the water subsided.

Kodur Channel embankment breached

Supply channels from the Pennar & channel fed tanks injured

The channel banks suffered not at all but the heads of many channels along the Pennar were more or less destroyed and 39 channel fed tanks were breached. Almost the whole of the Pennar river embankments were washed away. The damages to roads are estimated at Rs 80,000 in addition to the repairs essentially necessary. The District Engineer's recommendations under the provision of head sluices to the lower channels and the embankment of the Pennar river from etc north for a distance of 50 miles and other boards. The expenditure necessary or on prospective remunerated below.

Summary of expenditure required

	Repairs	Improvements
Irrigation works	Rs 20,000	Rs 35000.
Embankments		30000
Bridges	12000.	
Roads	30000	
	332000	365000

Grand total 697000

Salem District

26. Salem. In the Salem District the damage by heavy rain in September and October 1874 was confined to the northern portion comprising the Coimbatore and Erode ranges and at Trichinopoly in respect to tanks and the annicuts across Cauvery. It is gathered from the District Engineer's report that the cost of repairs would not exceed Rs 2000 and the improvements included as necessary amount in the aggregate

Flooded Sept & October 1874

Cost of repairs & improvements Rs 3500

having once penetrated into the low lands adjacent to the river proceeded to find its way to lower levels, washing away roads and destroying channels and banks in its course.

The details of the damage are fully described in the report of the District Engineer recorded under Lr. No 256 of the 29th January 1875. And the further account appended hereto gives other particulars and describes the measures which it is proposed to take to prevent similar accidents in future.

Appendix, 2

28. There are 5 old irrigation channels of considerable importance which branch off from the river at points above the town of Tuticorin and depend for their supply on annicuts on the river. There is also one annicut just below the junction of the Chittaur with the Vembaraparie 28 miles from the sea and another recently completed at Sheriporatoor about 15 miles from the sea. Both of these works feed channels on either bank of the river. The upper annicut the Marcher Kolattal channel on the west or right bank and the Kolelak on the left bank. The lower work is connected with the north channel on the left bank and the south channel on the right. The river is at present unbanked on both sides from Chittar at the embouchure to Maruntalore on the left bank and Nasuruttalam on right bank or about 18 Miles from the sea.

Annicut Marcher

Sheriporatoor Annicut

Left Bank Channels.

Defects in the existing Channels.

Measures have already been taken to provide the five channels above Tuticorin town as well as the Marcher Kolattal below it with head sluices. Generally it may be said that all these channels require considerable improvement. Their banks need in many cases to be raised to exclude river and the surplus weir provided have proved often of insufficient length to pass off the drainage crossing them and extensions are required. In other cases they have been breached by the river flood and their action wrecked and there have resulted extensive breaches from these and similar causes. The recent excessive of Shutters to the Kodagan and Tuticorn channels and consequent flooding of the town of that name and considerable damage to property

The same observations apply to the Chittar and to take off some about the Marcher annicut and in a less degree the north channel from the Sheriporatoor annicut

29.

29. A number of tanks overflowing into each other and finally across the channels above referred to and into the river require attention. Some have been breached owing to insufficient provision of escapes. The inner embankments require to be raised, strengthened and extended for they were not only breached where they now exist but flood water escaped in other parts. It is proposed to carry them up over the left bank to the west of Similapore and on the right bank they will be raised from Kaimajduria to Anlan to a height varying from 11½ to 6 above the flood level of 1855.

Defects in Tanks & river Embankments

30. The expenditure which will be necessary to carry out the repairs and improvements to the works in the Jumma-valley District is given in full detail in the accompaniment to the District Engineer's letter which will be found appended. It amounts to Rs 230840 of which Rs 42500 will

Expenditure on repairs &c. Rs 220840

Appendix B

31. No reports from districts other than those above referred to show that they were not visited by rainfall or floods of an unusual character.

32. The foregoing narrative compiled from the District reports shows that there was considerable variation in the extent of the floods and consequently in the damages sustained in the various districts and in fact that it was only in the Kendua, Bellore, Cuddalore, Chingleput, North and South Arcot and Tinnevelly that extraordinary efforts to protect the crops were necessitated.

Concluding Observations.

The floods partial in their effects.

33. The following is a summary of the cost of repairing the damages to irrigation and as far as it has been ascertained to other works which

Summary of Estimated repairs

urine there has been exceptional Rainfall. The cost of the improvements to existing works or of such new constructions as are considered desirable is also stated.

	Emergent repairs to Irrigation Works.	Improvements to Irrigation works required.	Damage to Roads Bridges non-irrigation works.	Total Damage to Public Works.
	No.	Rs.	Rs	Rs
Tiruppur	10,000	60660	~~7100~~ 2050 ~~total~~	~~7[illegible]~~ 7[illegible]50
Vijayapuram	2,885	1,115	6,850	13[illegible]7
Kistna	90,000	102,000	18129 ~~total~~	210120
Nellore	263,410	289,000	116500	5[illegible]10
Kurnool	22000	89000	30150	141150
Cuddapah	180,400	120000 × 102000 not yet known	30,000	[illegible] 330480
Chingleput	95398	298220		393618
Bellary	Reports awaited		out of current	
North Arcot	209000	not stated	146000	355002
South Arcot	209000	365000	173000	647000
Salem	2000	1500		3500
Trichinopoly	42500	170340 1427825	not stated	[illegible]
Total.	1129793	[illegible]	402928	3010546 [illegible]

~~2607 618~~
2607 618

The expenditure required on improvements only partially exposed.

It will be observed that the total cost of the repairs to irrigation works is estimated at Rs 1129793 and the proposed improvements will cost Rs 1427825 Thus an outlay is foreshadowed of Rs 2607618 chargeable against the resources available for Public Works Expenditure on irrigation works and the bulk of this expenditure is confined to the Districts of seven districts only. It is a fact to be noticed also that the exceptional rainfall in most cases only affected portions of the districts referred to and that consequently a considerable area of the irrigation works was subjected to the ravages of the extraordinary stream. The deduction is that similar floods in other districts would demonstrate

Cause of Disaster.

The cause of above excluded expenditure.

314. The disasters which have occurred all originated from the overflow of the various reservoir bunds material or parts of the bunds insufficient height or strength to withstand the pressure of the flood waters. The irrigation or tank feeding channels leading from these reservoirs were also more or less damaged with the exception of the Cauvery flood waters. The same violence the force of flood waters, they had overflowed and destroyed the bunds, they had overflowed the bunds and being thrown off proceeded on their course and thus were led to their former channels. In short the natural hydrographic lower drainage of the country has been largely interfered with and can as before drainage system has been established

Immediate cause of the disasters the same generally

established which does not provide for abnormal conditions, conditions which however recur unfailingly at intervals more or less great. That the rainfall during the months of May to October 1874/75 was generally of a very exceptional character is shown by the following statement which comparing the average for the several districts with the fall during these months of 1875.

Rainfall
May to October
1874.

Rainfall in six months May to October

	average of four years previous	1874-75
Georgetown	39.02 Inches	41.90 Inches
Vizagapatam	36.57 "	27.00 "
Kistna	23.52 "	32.80 "
Nellore	23.62 "	35.22 "
Chingleput	27.50 "	31.90 "
North Arcot	28.06 "	31.22 "
South Arcot	27.55 "	39.32 "
Bellary	21.13 "	28.09 "
Cuddapah	21.57 "	49.19
Kurnool	25.96 "	45.39
Salem	28.09 "	35.54
Coimbatore	7.15 "	7.32

It is not all probable that any arrangements which can be made will obtain that all times prevent loss from extraordinary floods. The [illegible] of the Po, the Rhone, the Loire and the Garonne and other rivers in Europe shows how difficult it is to effectively work and control the drainage of a country - but much may be done to ameliorate matters and in no branch of engineering are successful operations more immediately and largely productive of good than in that connected with the improvement of rivers.

The

35

20

General proposition of District Engineers for the improvement of rivers

35. The proportions made by the District Engineers in this direction involve the construction of embankments or the extension of those already existing on the courses of the Godavery, the Pennaur, the Cleyar, the Palar, the Ponnaiyar and the Coombaporumy, and the provision of sluices to the heads of the channels taking off from those rivers for purposes of irrigation. The details of such embankments will depend as well their successful application, on a careful study of the regime of the several rivers, their surface levels during flood at all points and the effect of the proposed embankments and channels in increasing the flood level, a knowledge of the flood discharge is therefore necessary and considering the complications introduced by the hindering of embankments and the consequent expansion of the water spread during the most critical period it is by no means easy of attainment. The work to be done is each case and very careful adaptation of the means to the end is necessary in each case.

Nature of improvements required in irrigation works

36. The improvement of the existing irrigation works - the provision of sluices and escapes to tanks and of circular work to channels with the object of enabling them to pass the surplus drainage of the country has also been suggested, and works are being carried out which

while estimates for others are in course of preparation.

Rec'd

20th Oct 75.

f. 0.12 Feby-75. 282-284
12 Dec 74. 239-240
4 Dec 74. 85a.
Desp: to Secty of State No 1. 12 Feby 75

Rec'd 22-9-75 Rec'd 29-9-75
Rec'd 30-9-75 Rec'd 21-9-75
F.L. Shut 17 Oct

P. W. 1895 Sept.
No. 6288

From

The Chief Engr.
for Irrigation.

Dated 21 Sept. } 1895.
Rec'd. 1 Oct. }

G.O. 1086 A.

Statement showing the nature and extent of damage done to the Irrigation works of the Chingleput District by the exceptional floods of Sept. and Oct. 1894.

G.O. No 2780-81-2995.

Public Works Dept.

No 2780

Proceedings of the Madras Government
Under date the 29 Sept. 1895
Read the following

Memo. by Chief Engr. for Irrigation } (G.O. No 1086A dt 20th Sept. 1895)

The Govt. have from time to time had information placed before them which has indicated that the anicut and irrigation works of this District were in a state ill adapted to withstand the strain arising from heavy rainfall. In consequence numerous [illegible]

severe character there has generally been a long list of damages of a more or less important character. After however a series of comparatively dry years, 1872 was the first in which a storm in May and very heavy rain on the setting in of the North East Monsoon showed very clearly that of the vast numbers of tanks on which so much of the cultivation in most Districts depends very many were incapable of holding out under such emergencies, while inundations, which to a great extent are preventable, caused wide spread destruction of crops and property both public and private. District officers as a rule had not then recognized the radical defects of the irrigation works generally, the greater number of which are of Native construction and were adapted by their builders only to seasons moderate in character, while for the most part the effect of connected works upon each other, as in the case of groups of tanks, had been altogether ignored by their constructors. The Irrigation Dept. took measures however for the more intelligent treatment of irrigation works

work generally, and though these could not affect materially the character of the work done in 1872-73, their effect has been already felt wherever the instructions obtained prompt attention. Consequently in 1874 the tanks were in far too many cases notwithstanding large outlay on repairs during the interval, but little better calculated to be safe under severe strain than before.

2. The essential requirements of irrigation works and the conditions of safety having since however been recognized and District officers having been fully instructed as to their proper treatment, it will be expected and required that in every case damage from preventable causes will in the future be guarded to the utmost extent possible with the means which Government may be able to place at the disposal of the officers concerned.

3. The urgent need of additional funds especially for Minor New Works, under which head means of supplying of canal water must be

be provided has after full enquiry and consideration been admitted by Govt. and the necessary representations have been made to the Govt. of India who have in their letter as per margin called for further information on some points, and this is now being collected.

No No 475 of 17 Feb/95

No 214 A I of 21st July/95

4. The papers now reviewed show that the more repair of damage sustained by irrigation works from the floods of one year in a few Districts will cost upwards of 11 Lakhs of Rupees, and necessary improvements to remedy apparent defects and remove the probability of a recurrence of similar damage have been estimated to require 14 3/4 Lakhs, while it may very safely be assumed that when the works come to be dealt with individually the latter amount will be considerably exceeded. In the Godavery for instance, a District not affected by the floods of 1894, and not included in the list, it is known from more recent reports that the freak of 1895 was a cause of serious and

and imminent danger to the Delta and that precautionary measures must be taken at the earliest possible moment to avert such a calamity as any general breaching of the flood banks would undoubtedly be.

5. Formerly but little was known of the state and needs of irrigation works and, in the absence of information, but little could be done to introduce improved management, and, unfortunately much of the money expended on more repairs

proved useless. Now that attention has been called to the subject, that the direction and extent in which action is required have been generally ascertained, that at least so far as the means of making investigations necessary to the determination of details provision has been made, and that funds both for repairs and improvements generally, [illegible] have to some extent already and will doubtless to a greater extent ere long be made available

available it is absolutely
necessary to the credit
of all concerned that
every year should show
a marked reformation
in the state of the
works, and that all
the work that may
be carried out should
be such as will lead
to the ultimate complete
security of all works
which are so circum-
stanced as to allow
of this object being
attained. River con-
servancy, the regulation
of the heads of river
channels, the repair
of and provision of

surplus works for tidal
use, all need steady
and continuous atten-
tion, and in each
and all of these cases
the first thing is to
ascertain clearly all
causes of danger, and
then the most effectual
and most economical
way of removing it.

6. The subject of
this order being very
intimately connected
with the grants under
Agricultural Ordinance
a copy of these Pro-
ceedings will be for-
warded to the Govt of
Judicial Extinction

of

of date of the 17th
Feby last No. 475-

No. 2019

Docket No 27817 29 Sept/75.

Copy of the above forwarded to the Govt of India.

Office 17
Copy Index — 26

Disp - 25-10-75-

SC Disp'd - 19-10-75-

No 590/93

Secy of State 4 Encls:
Clerks for Engrs — 5 wks
Rev. Dept. — 10 d
Engrs — 13 d
Officer 17

Public Works Dept.

63

To
The Most Honble
The Marquis of Salisbury
Secy of State for India.

My Lord Marquis,

With our despatch of the 12th Sept. 1875 No. 1 we submitted a narrative showing the nature and extent of damage done to Railway works by the extraordinary floods of Sept. and October 1874 and we have now the honor to forward a statement of

of the effect of those floods on the Irrigation works of the Presidency.

It will be seen from our Proceedings, which are also transmitted, that upwards of $25\frac{3}{4}$ lakhs of Rupees will probably be required to repair the damage sustained and carry out such improvements as may be calculated to render the works secure for the future. The subject of irrigation works has of late years been taken up and treated in a more comprehensive manner, with a better knowledge

knowledge of actual requirements, and it is hoped that with a more ample supply of funds a marked improvement in their condition will ere long become apparent.

Lay 2/17

Copy.

Forwarding a statement showing the nature & extent of the damage done to the Irrigation Works of the Presidency by the extraordinary flood of Sept. & Oct. 1874.

62857

Govt. of Fort St. George.

PUBLIC WORKS.

To
Chief Engr for Irrig
Secy of State

Dated

Rect.

Ans.

G.O. 29th Nov. No. 2781-81.

Rect. 5 10 - 5 12
5 13

Forwarding copy
Prop: on Memo:
the Chief Engr:
Irrigation subm:
a statement
the nature & extent
of the damage
to the Irrigation
of the Presidency
by the extraor:
floods of Sept:
Oct: 1874.

Damage done to the Irrigation
Works of the Presidency by
the extraordinary floods
of Sept: & Oct: 1874.

Forwarding orders on
Memo: of the Chief Engr
for Irrigation submitting
statement shewing the
nature & extent of the